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Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY
OCTOBER 1989
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WHEN HAZARDS THREATEN, TELEROBOTS GO WHERE HUMANS CAN'T

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OCTOBER 1989 VOL. 92 NO. 7

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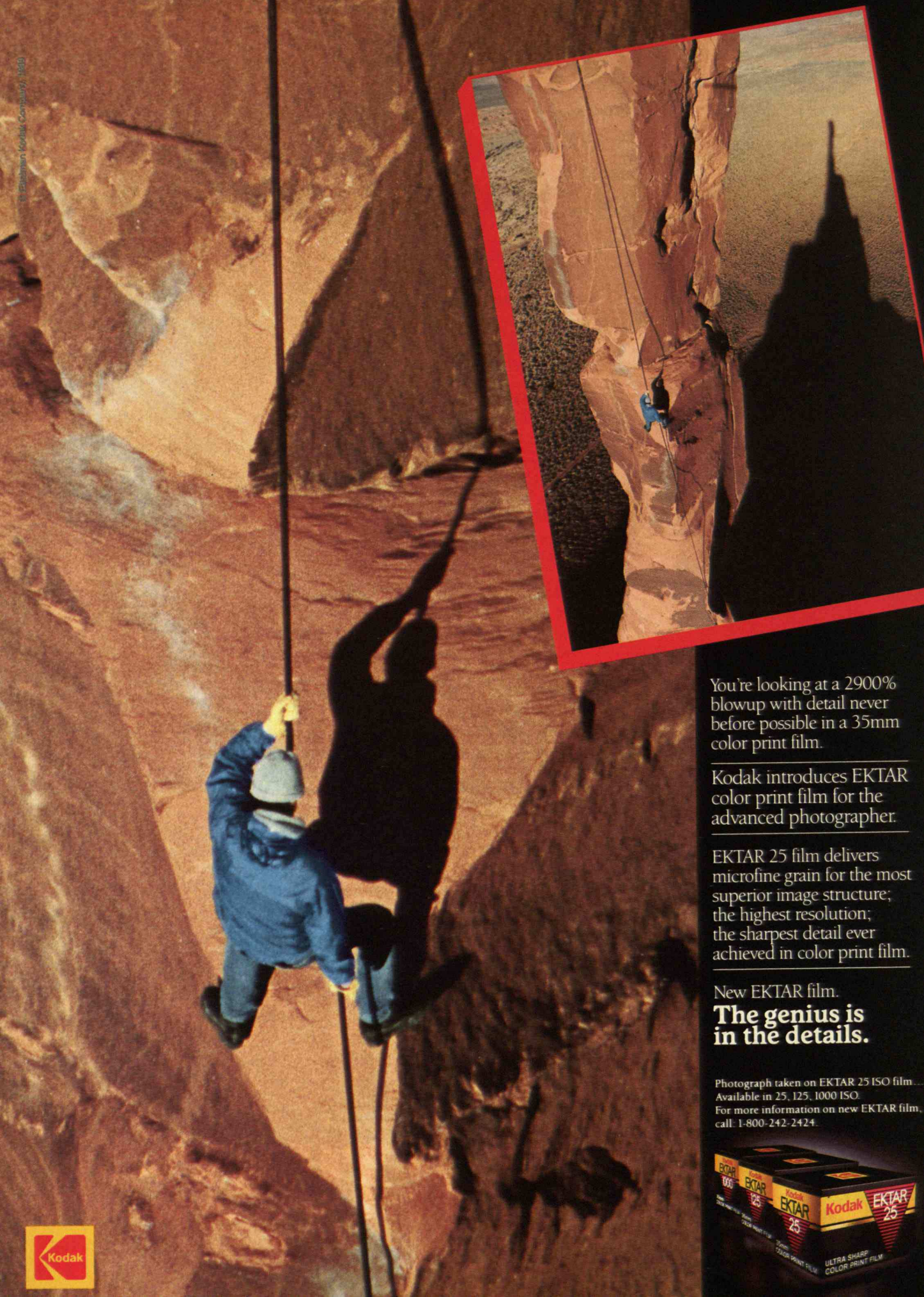

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Renovation and the Housing Crisis

"This Old House," the public-television series that embodies the renovation mentality, omits the often grim preamble to the construction. That part became all too vivid when a real estate agent showed me an old three-family house, a type common in Boston, selling for $65,000 a unit. As we walked through one apartment, we met a white man of perhaps 80 standing rigidly in the kitchen. His wife, a black woman of 65 or 70, was bustling though various rooms. When she turned toward me, I saw tears on her cheeks. She knew their $250 rent couldn't pay for $65,000 worth of mortgage.

That decided the matter: I found an empty lot to build on. A vacant wood house had burned in 1976, and the owner, one Gretchen Mueller of Panama City, sold the property for $100, so highly prized was land for new construction. I tracked down the subsequent owner through the tax records and bought the lot. I hoped to build a two-family to help with the mortgage payments, and I congratulated myself that by adding to the Boston housing supply, I would do my small part in ameliorating the housing crisis.

It wasn't so easy. Up and down my street were many two- and three-families, but current zoning laws allow only a one-family. I happened upon an actual measure of the cost of this discrimination. A crumbling, burned-out brick shell occupied a lot no larger than mine but was being sold for five times as much. Part of the reason was surely that, as an "existing" three-family, the shell entitled the owner to three units.

As I explored the issue further, the evidence became increasingly persuasive that the nation's housing crisis results mainly from too little housing. New construction has not added enough units, and renovation has taken too many units from low-income families. Todd Swanstrom of the State University of New York at Albany documented this phenomenon recently in *The Journal of Urban and Contemporary Law*.

After World War II middle-income Americans moved to the suburbs, abandoning urban areas to low-income families who may have lived in slums but at least did not live on the streets. But in the 1960s, through zoning and other controls, suburbs began to reduce the availability and increase the cost of new houses. Over half of the land in towns in Westchester County north of New York was zoned for two acres or more. Marin County near San Francisco issued a moratorium on water hook-ups. Some home buyers paid higher mortgages, and some returned to inner cities to renovate.

Encouraged by federal programs such as Community Development Block Grants, renovation took units from low-income families. As their housing supply dwindled, some of these families paid more rent. The average single-parent household pays a staggering 58 percent of its income in rent, according to a 1988 study by the MIT-Harvard Joint Center for Housing Studies. Some became homeless. Note that the problem arose from lack of housing, not poverty alone: as unemployment declined during the 1980s, homelessness increased.

The process of appealing for a zoning variance can take on Kafkaesque proportions, as I discovered when I sought to build a two-family. The Inspectional Services Department (ISD), as the building department is officially called, provided the wrong form. The ISD's Zoning Division duly noted the provisions of the code that I would violate but failed to notice the paperwork error. The Boston Redevelopment Authority also scrutinized the wrong form. The neighbors were notified of my intentions, and I talked with them. Four months later as I nervously put my case to the Zoning Board of Appeals, a commissioner discovered the procedural error. My case was "dismissed without prejudice." Rather than start over and delay construction into winter, I built a one-family.

Unfortunately, more liberal zoning codes than exist in Boston would not suddenly produce a raft of new homes. While a ballpoint pen shortage can be remedied quickly, housing takes a long time to build. Just try to find a plumber when you need one. Moreover, the number of lots to build on is limited, as the Boston Public Facilities Department, which is trying to produce housing on parcels it owns, has discovered. An educated guess based on a 1987 survey by the department suggests that of 16,500 vacant parcels in the city, about 3,500, averaging some 45 feet by 100 feet, are buildable. (Others may be odd-shaped fragments, under water, or already leased.)

Still, it makes a difference whether you can build one unit or three. Rental income

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Technology Review, Building W59, MIT, Cambridge, MA 02139
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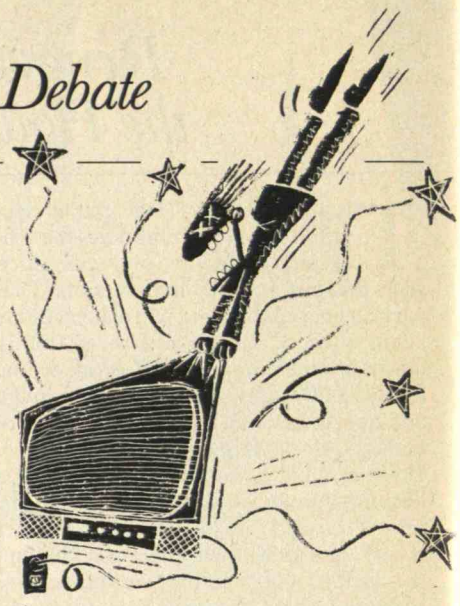
HDTV Debate



TVs FOR STRONG AMERICA

I can forgive Langdon Winner some of his hyperbole, but his vision of technology development is cranky and way off base (*"Who Needs HDTV?" TR May/June 1989*). Does he truly believe the Defense Advanced Research Project Agency will spend $30 million on HDTV technology so that the nation can watch a clearer episode of "Dallas"? (In truth, I bet he doesn't even watch "Dallas"; I know his type.)

Mr. Winner shouldn't be so quick to pooh-pooh technological advances, even if their purported purpose may be an improved look at the Dallas Cowboys or those sex-crazed Ewings and their women. The reason is that what looks like a better television screen to him may look like a better radar screen to someone else. What looks like a room full of television techies to him may look like a room full of highly skilled electronics workers to someone else.

We mere mortals are too sluggish and dumb to play technology traffic cop—deciding in advance which technology is worthy of our respect. The market will determine whether we want better televisions. And the laboratories and clinics of the world will figure out how and when to develop associated HDTV technology for purposes that Mr. Winner may find more intellectually satisfying.

LAURENCE D. COHEN
Hartford, Conn.

Although I partially agree with Mr. Winner that our dollars would be better spent on social programs than on HDTV, I believe we have a critical mission to accomplish via this new technology—that is, to retain, if not strengthen, our global economic dominance. The issue here is not better TV pictures as Mr. Winner simplemindedly argues. Rather it is the possibility that our worldwide economic power and political influence could suffer if the lead in HDTV goes to our most fierce competitor—Japan.

CHI C. LUU
Cincinnati, Ohio

Langdon Winner seems to have misinterpreted the reasoning for investing in HDTV. Instead of providing a one-time funding allotment for social programs as he suggests, we should invest this country's tax revenue in new commercial technologies. This type of investment will be returned to society in increased employment, and in possible technology spinoffs. These should provide benefits to society over the long term.

Furthermore, the notion that HDTV is not what the public wants is absurd. Historically, Americans have been willing to purchase the latest in home entertainment products. As for Winner's contention that the HDTV investment dollars would be better spent on improving the quality of television programming, quality is not the problem. Cable television has provided many admirable selections such as CNN, CSPAN, Discovery, A&E, and ESPN, and that's in addition to the potpourri on PBS. Since Americans spend more hours watching TV than doing any other recreational activity, it appears that people aren't having any trouble finding the programs they desire.

THOMAS R. HOWARTH
University Park, Pa.

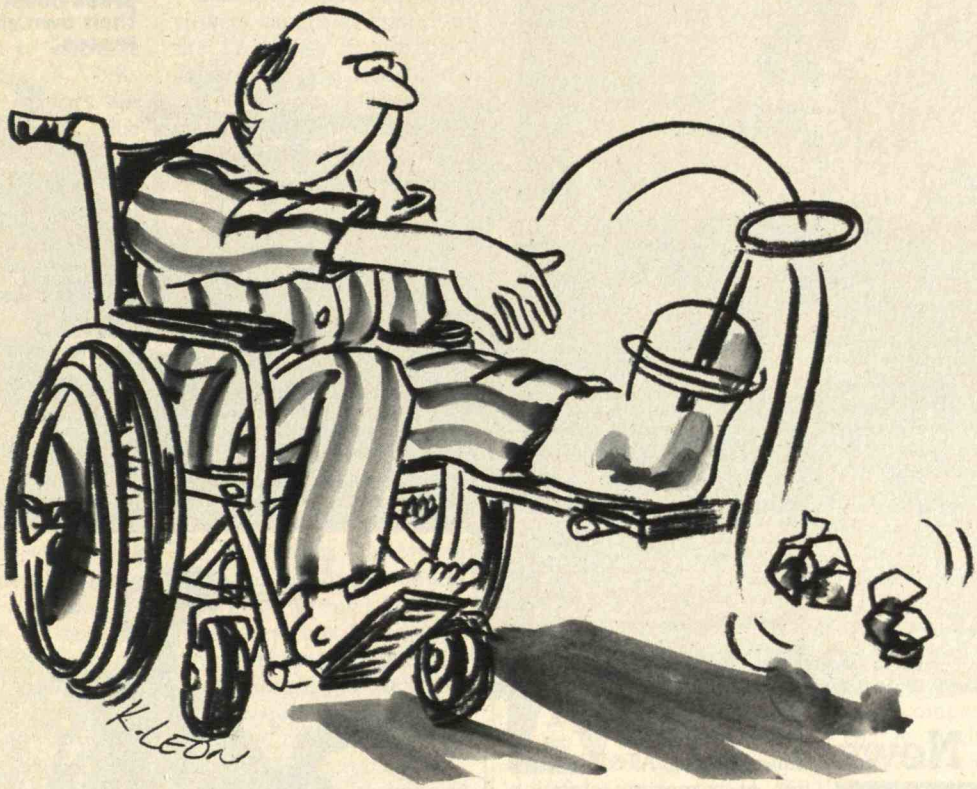
The author responds:

None of the mail I've received on HDTV explores the question I raise in my column—namely, whether there is any important social need that the technology itself serves. In fact, proponents of HDTV seem to be ready to adapt social ends to match whatever HDTV and its developers might require. Just wait a few years (decades?), we are told. HDTV wealth will start pouring in, and we'll have enough money for the things we really need: better health care, housing, education. This urgent backward logic is, unfortunately, buttressed with images of technonationalism that only cloud the issue further.

There is one point upon which my critics and I might find common ground, however. If HDTV is bound to be such a smashing success in the marketplace, then surely we can reject the requests for $1.3 billion in federal subsidies to get this electronic dirigible off the ground.

Continued on page 76

What would several months in this position do to your financial position?



If you're unable to work due to a major injury or prolonged illness, you could find yourself in a very uncomfortable financial position.

Because while you're losing income, the monthly bills keep coming. And when you add on medical expenses to mortgage, credit and car payments, before you know it, your financial security could be seriously threatened.

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TRENDS

After the Alaska oil spill, Exxon joined the ranks of firms that try to shape press coverage through their own video news releases.

Prefab News

The voice work is smooth, the visuals dramatic, and the testimony expert. Television spots that subtly tout products, services, and viewpoints are flooding stations, which air them as part of their regular news broadcasts.

Critics say video news releases—VNRs—blur the line between reporting and advertising. "It's appalling," says Todd Gitlin, a sociologist at the University of California at Berkeley. He calls them a step "on the slippery slope to accepting someone else's prefab news blip."

Advocates argue that VNRs provide hard-to-get footage and expertise. "We're trying to be responsive to the needs of the media," says Linda Evans, AT&T's director of corporate television. She says AT&T gets national coverage via VNRs and donated stock tape at least three times a week.

Each week, hundreds of stations, ranging from tiny independents to major networks, air tapes from such groups as Genie Garage Doors, Burger King, and the American Medical Association (AMA). MediaLink, the biggest VNR distributor, offers 548 subscriber stations more than 800 segments a year via satellite. The firm also contacts 200 non-subscribers, reaching three-fourths of the U.S. market in all.

"Our job is to deliver a specific message, to create an awareness and change people's perception," says Caren Kagan, president of the Broadcasting Center in Washington, D.C., a public-relations firm specializing in VNRs. "The intent is to generate media coverage and give the media an idea of how to report the story."

VNRs closely resemble TV news features. After an anchor's introduction, visuals and expert comments tell the "story." Producers avoid the hard sell. Instead, the spot might feature a company "expert" or just one shot of a product or company logo—Amway tapes of the Indianapolis 500 simply show the car it sponsors in front.

Companies make VNRs in part because they are cheap—$5,000 to $15,000 compared with $100,000 per minute or more for prime-time ads. And they may be more effective "because of the context in which they're seen," says Dick Reizner, a VNR producer in San Jose, Calif. "Since they're on the news, people tend to believe them more. They think it's part of the newscast."

However, monitoring the number of stations that pick up a release is problematic. Voluntary feedback—postcards or phone calls—is unreliable. Kagan estimates that 10 to 15 percent of the stations the Broadcasting Center

PHOTOS: UPI/BETTMANN NEWSPHOTO; AL GRILLO/PICTURE GROUP, INC.

contacts pick up any one VNR. Reizner says that 80 percent of the local stations pick up his pieces.

It's also hard to calculate the total number of VNRs aired, although stations are deluged with offers. Cathie Abookire, assistant editor for Philadelphia's WTXF, gets "a couple of calls a day." At Oakland's KTVU, Mark Richardson receives "hundreds of offers a week, for everything from ice cream to medicine."

Controlled News

Companies, non-profit organizations, and marketing firms produce these eye-catching spots. Barry Cohen bases the AMA's weekly feature on the lead story in the *Journal of the American Medical Association*. He says the program "just gives the information and footage stations can't get."

Greenpeace sponsors VNRs, including segments on its rock album and on toxins in the Great Lakes. "Stations rarely cover environmental issues thoroughly," says Greenpeace media director Peter Dykstra. "It's a good opportunity to give stations footage they couldn't otherwise get—for instance, footage from Antarctica."

Exxon is a recent convert. Soon after one of its tankers spilled 10.9 million gallons of oil in Prince William Sound, viewers saw a VNR with stunning shots of Alaskan scenery and majestic cruise ships. "It's cruise time in Alaska, and business is booming," a narrator announces. "As for the port called Valdez, none of the cruise lines are skipping it." The piece continues with testimony from happy tourists, shots of whales, seals, and glaciers, and the news that concerns about the spill "seem to [have] abated."

Between 27 and 30 million viewers caught at least 1 of the 12 VNRs Exxon produced during the height of the crisis, says public-affairs manager Jim Morakis. Exxon had considered making such spots before, "but when this crisis occurred, we decided we better start doing them now."

Despite their need to fill news time, many stations are cautious about VNRs. Some editors say packaged spots limit control over sources and footage. For example, KTVU's Richardson worries that firms use VNRs "as an alternative to talking to reporters."

Eric Scholl, a Cable News Network producer, agrees. Like many of his colleagues, he insists that "we would never ever use a pre-packaged thing. Sometimes we'll pull footage out of one but only as a last resort." Scholl refused to run Exxon's tapes.

Stephen Awg, business editor at ABC News in New York, airs several VNRs a week but always identifies the source on-screen. "I usually edit them," he adds, "and I'm always willing to edit in the other side."

Even such caution doesn't satisfy skeptics. Mark Bakst, a video producer at Lorain Community College in Ohio, says VNRs create what he calls "selective viewing." "You see footage of a nursing home and it may seem like Little Miss Mary having a good time, but you don't get to see how they neglect her the rest of the time." ■

SUSAN E. DAVIS is a San Francisco free-lance writer and a correspondent for Pacific News Service.

Waterjets can slice through materials so hard that diamond-tipped saws bounce off without making a scratch.

Waterjets

As the room fills with a roar, the needle-thin stream of water moves to a slab of carbon steel and slices it cleanly and quickly in half. Charles Burnham reaches over with a bare hand and picks up the metal, which is barely warm to the touch.

Burnham, a graduate student at the University of Rhode Island (URI), is operating a waterjet. This high-tech knife carves up ceramics so hard that diamond-tipped saws bounce off without making a scratch. The same machine is delicate enough to bone fish.

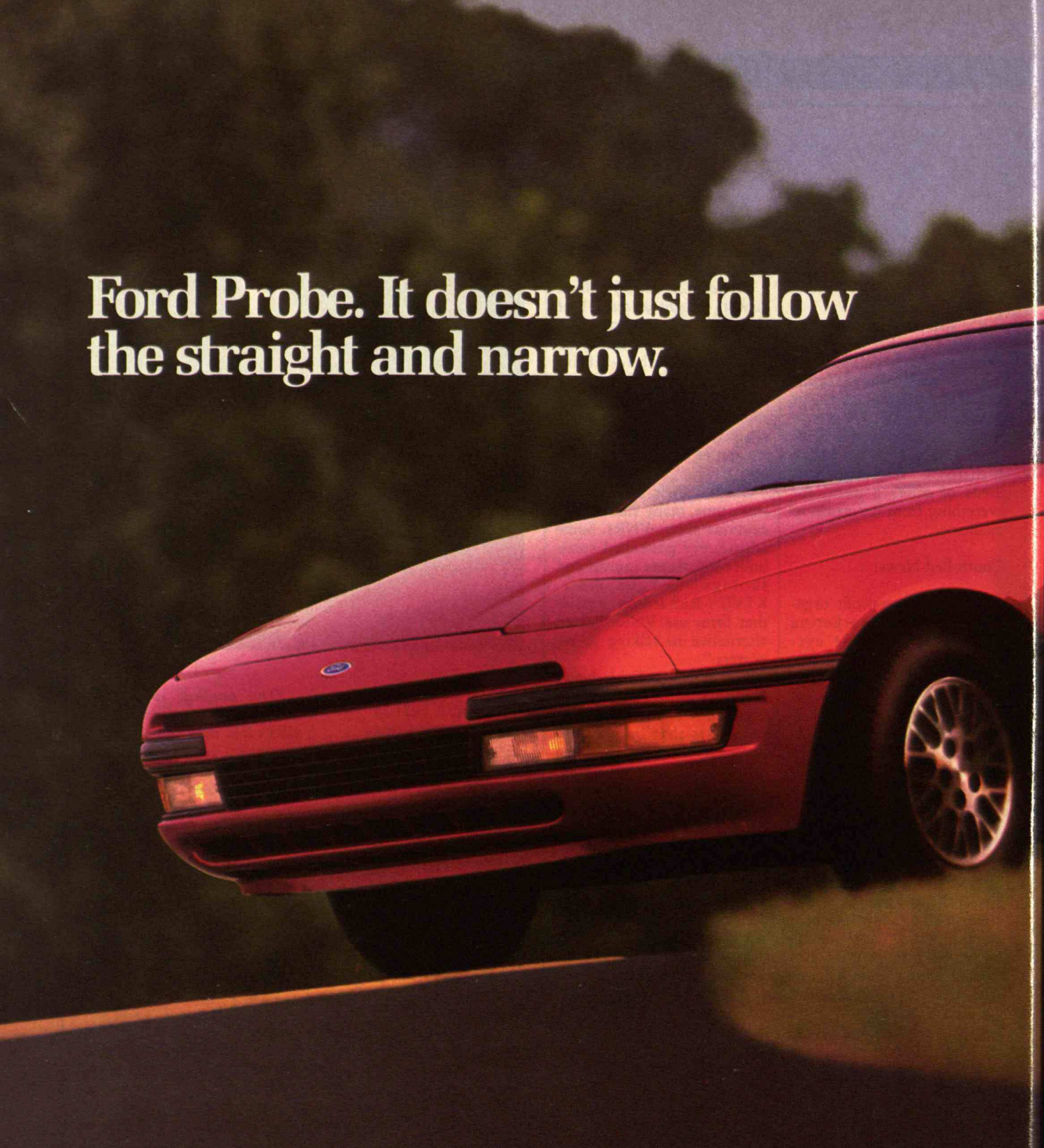
In 1986, only two universities, URI and the University of Missouri, were experimenting with the technology. Since then, the Georgia Institute of Technology, the University of Texas at Arlington, the University of Wisconsin, and New Jersey Institute of Technology (NJIT) have entered the field.

One reason is speed. Thomas Kim, director of URI's lab, took but a minute to make a 1.4-inch-long slice in an inch-thick zinc-nickle-steel composite. Electro-discharge machining, a widely used way to make fast and clean cuts, goes through only a tenth of an inch. Waterjets zip through inch-thick pieces of aluminum at a rate of four inches per minute. And while lasers don't cut transparent materials, waterjets dissect a foot-and-a-half of inch-thick glass in a minute.

In fact, a waterjet can cut any material without heating it and without the distortion that characterizes many other cutting methods. And this knife releases no toxic dust and never needs sharpening. The water stream captures all the dust, which is then filtered out in a collection tank.

Actually, waterjets have been around since the 1950s, but early models were slow. Thus, they were used primarily in mining. In the early 1980s, Flow Research, Inc., of Kent, Wash., added abrasives to the stream, boosting

PHOTO: FLOW SYSTEMS, INC.



Ford Probe. It doesn't just follow the straight and narrow.

While most automobiles seem to travel a well-beaten path of look-alike design and performance, Ford Probe moves along different lines.

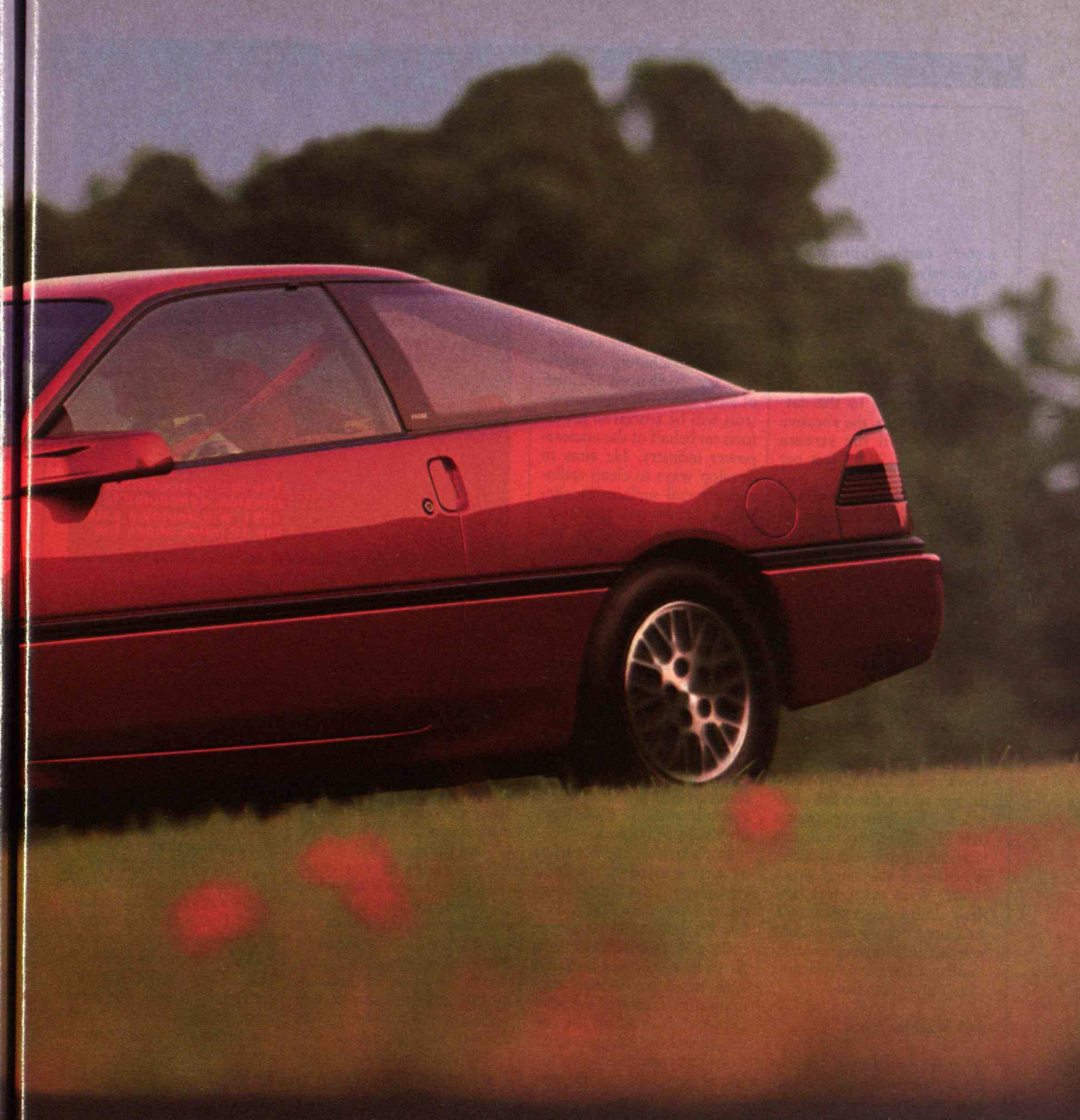
Inside and out.

Take the different lines, for example, that make up its sleek exterior. Probe cuts a figure as dynamic as it is aerodynamic.

Probe's interior also gives us plenty of room to talk. Intelligently laid out, with easy-to-reach controls and considerable interior space (for both front *and* rear seat passengers), it's one sports coupe that won't leave you cooped up.

Up and gone.

And with Probe LX's newly available



3.0 liter V-6, you'll find it easy to move out on the road. Quick, responsive, and coupled with a tight-handling suspension, Probe turns corners as well as it turns heads.

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Have you driven a Ford...lately?

Ford

water's cutting ability tremendously.

The process filters tap water to remove particles larger than .45 microns. Compressed to as much as 60,000 pounds per square inch (psi), the water moves through reinforced hoses to the cutting head. There, the abrasive is added, and the stream shoots out at 2,000 feet per second.

At URI, Kim has worked extensively with industry to apply the technology. Besides boning chicken for a McDonald's supplier, he has cut fiberglass pieces for car manufacturers and milled ceramics for Pratt and Whitney jet engines. Much of his research focuses on specialty ceramics in engine blocks and turbine blades.

Under a grant from the National Marine Fisheries Service, Kim has set the jet at its lowest power—10,000 psi—to save scraps from fish skeletons. The agency estimates that $5 million worth of fish is wasted each year because removing it takes too much labor. With waterjets, the flesh almost melts off bones. And since this cutting is done without an abrasive, no metal shards or machine lubricants contaminate the fish.

3-D Machine Tool

At NJIT, materials scientist Ernest Gefkin and his colleagues are analyzing the physics of waterjets. One study investigates the shape of the jet stream, while another looks at how the abrasive particles are distributed in it.

In addition, Gefkin is making three-dimensional waterjet cuts with a computer-controlled robot. Creating a cone out of a rod-shaped piece of material normally requires shaving off the excess material gradually. But a 3-D waterjet set-up accomplishes the task in a single pass, saving wear on expensive finishing machines.

Other studies are expanding such machining capabilities, says Mohamed Hashish of Flow Research. Robot controls will be crucial to his efforts on behalf of the nuclear-power industry. He aims to develop ways to clean radioactive metal surfaces by slicing a layer off the top. Hashish also wants to find out whether waterjets could cut up the five-foot-thick concrete walls of a containment building when a reactor is decommissioned.

Despite the optimism, obstacles remain. While several industries cut simple shapes with human-controlled waterjets—perhaps 300 units have gone into service since 1984—robot-controlled waterjets are too primitive to be commercially viable. "This is a new frontier, so it's still got problems," says Kim.

In particular, the accuracy of current waterjets "is good enough for general machining but not much else," says Gefkin. Projects are under way to make a 10-fold improvement, partly by combining waterjets with more traditional techniques for finishing. Another approach is to adjust the cutting speed for each material. Faster cuts yield a rougher finish as pieces of the abrasive lodge in the work.

Longer-lasting nozzles are needed as well. The high-pressure stream can wear out the type of tungsten carbide now used after only a few hours. But, says Hashish, a new formulation of these materials lasts up to 50 times longer. ■

ROBERT HAMILTON is a science and technology reporter for the New London, Conn., Day.

The first space-tether mission, scheduled for 1991, will deploy a satellite 12 miles above the shuttle.

Space Tethers

It's the fabric of space adventure novels, a galactic web of homes, labs, and craft. Cable cars ferry people and supplies along the city's network, and instruments dangle at the end of long leaders.

This vision is not completely starry-eyed, according to engineers and scientists who are ready to try out the lifeline of such an astral port. The first big test of a "space tether" will be in January 1991, when the shuttle will unreel a 12-mile-long cord from its payload doors.

The tether line—strong, lightweight and about as thick as a shoelace—is made of layers of copper wire, Teflon, and Kevlar braided with Nomex, a rugged plastic sheathing. At its end will be a small satellite whose mission is to gather data about the electrically charged particles swimming in the Earth's ionosphere. The tether will also carry plasma-physics and electrodynamics experiments, including one to determine whether the copper wire can generate a current as it moves through the ionosphere.

When it is time to deploy the satellite, springs will kick it out of the shuttle payload compartment, and a boom with pulleys will unravel the tether upward, away from the shuttle and the Earth. Small thrusters on the satellite will move it away from the shuttle until it is about a mile out, at which point the Earth's gravity should pull the line taut.

The principle at work here is the basis of tether technology. The pull of gravity is slightly stronger on the lower end of a cable, attached in this case to the shuttle, than it is on the upper end. The difference in force should extend the tether vertically. And the reverse should work, too: a tether lowered from a shuttle should pull downward.

However, the theory can't be checked out until a "tethered-satellite system"—TSS—is dangling in space. "This is one type of device that no one can come close to testing on Earth," says John Anderson, manager of large space-systems technology at NASA headquarters.

Moreover, researchers have questions about many possible microgravity effects.

ILLUSTRATION: MARTIN MARIETTA CORPORATION

The principal concern, according to Anderson, is one of "simple dynamics." What happens when objects are fastened at the end of a flexible tether? "We have predicted what we think is going to happen, but that won't be validated until the tether is out in space," Anderson observes.

Another unknown is the effect of collisions with meteors or space debris. And scientists also wonder about the results of applying tension on the tether to reel it in. "In gravity, if a cord is broken it snaps back. What will it do in space?" Anderson asks.

Large Pizza to Go

Italy and the United States have been collaborating on tethered satellites since 1982, splitting the cost of developing the system. A large part of the $100 million price tag is going to build the tether deployer, the boom that sends out and reels in the line. That project is nearing completion at Martin Marietta in Denver.

If TSS1 succeeds, a second tethered-satellite system, tentatively slated for late 1994, will send experiments over 60 miles downward to test the upper atmosphere, an area Anderson calls the "ignorosphere." Too high for balloons or aircraft and too low for the shuttle, this thin layer of air absorbs a large part of the sun's ultraviolet, infrared, and gamma rays. That deposit of energy is important because it affects the birth of weather patterns on Earth.

Scientists see many dramatic ways to apply tether technology. For example, in 1972 Mario Grossi of the Harvard Smithsonian Center for Astrophysics came up with the concept of reeling long antenna from shuttle craft, and now he envisions free-orbiting arrays of interconnecting tethers. He refers to the construction as a "wheel of fortune" or a "pepperoni pizza."

It would certainly be the world's largest pizza. One design features a web of Kevlar wires in loops 200 miles across. The 50-ton array could be used as a receiver for radio astronomy or for communications at extremely low frequencies.

Grossi's colleague, Enrico Lorenzini, is working on tethers that might provide an adjustable gravity field for a proposed space station. The gravity pull on a tethered lab would be zero at the station's center of gravity and grow in proportion to the length of the line.

Still other scientists revealed their visions—and their computer analyses—in May at the Third International Conference on Tethers in Space. That meeting, held in San Francisco, was cosponsored by NASA and Italian and European agencies.

Anderson, a conference chairman, says the event attracted 250 scientists, all of whom are beginning to "work with tethers, sensing that they will be a tool for space research." He points out that the technology is "moving from an arena of conceptual study to one of more confidence and better analysis."

One San Francisco scheme was to tether a shuttle and space station together. Another proposal suggested tying an unlimited number of platforms around the station with a weave of rigid lines. Each platform would have its own orbit, with intricately timed arrival and departure times at the hub. ■

RENEE TWOMBLY was a Knight Science Journalism Fellow at MIT.

Slow Viruses

Research on a mysterious protein that is implicated in a family of rare nerve diseases may offer clues to aging. It could also help unlock the secret of Alzheimer's, one of the worst diseases afflicting many people as they age.

Microbiologists have dubbed the substance PrP, for protease-resistant protein. The abnormal molecule resists a normal process in which an enzyme protease cleans old proteins out of cells.

PrP seems to play a crucial role in three fatal diseases of the central nervous system—Creutzfeldt-Jacob disease (CJD), kuru, and Gerstmann-Straussler syndrome. In all these disorders, PrP clots accumulate in the victims' brain cells. Moreover, PrP may contribute to the formation of microscopic spongy holes that form in their brains.

A relative of PrP—without a separate name of its own as yet—is also found in normal brain cells, as well as those of the heart, lung, and some skeletal muscles. But its function in healthy cells is a mystery, according to David Bolton, a scientist at the New York State Institute for Basic Research. "It must be doing something worthwhile, but we don't know what that is."

In Alzheimer's and CJD alike, protein growths clog brain cells, and both diseases produce some of the same symptoms. Paul Brown, medical director of the National Institutes of Health's laboratory for central nervous system studies, suggests that the diseases "may be two different forms of a common process." Thus, research on one could shed light on the other.

But Brown is careful to distinguish between CJD and Alzheimer's. They involve different proteins—Alzheimer's patients don't appear to have abnormal PrP. And, the protein accumulations look different—long, thin filaments in Alzheimer's and rods in CJD.

The most glaring contrast, says Brown, is that "CJD is transmissible, but Alzheimer's most certainly is not." Researchers know that CJD is transmitted because

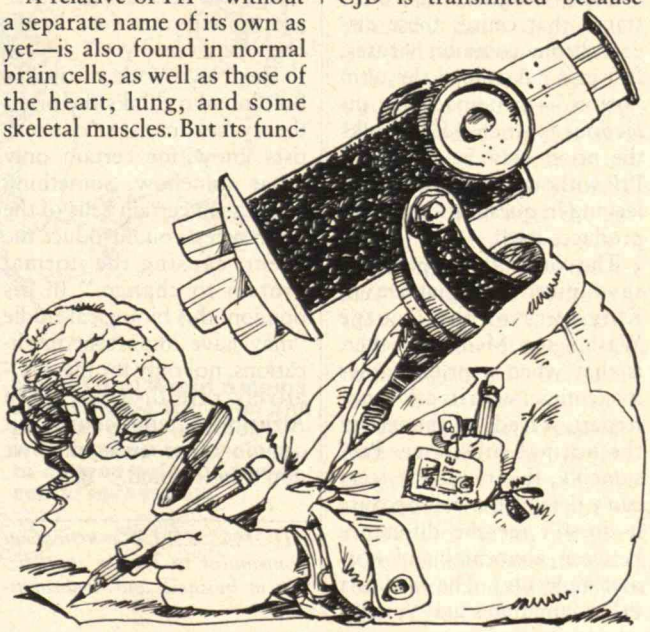


ILLUSTRATION: JON McINTOSH

"medical misadventures," as Brown calls them, have caused at least 20 cases. Physician-induced CJD has been traced to cornea transplants from donors with the disease, hormones taken from people who died from it, and surgery using contaminated instruments. Similarly, kuru, a related disease in New Guinea, sometimes comes from cannibalism. CJD, kuru, and scrapie (a disease in sheep and goats) can even be spread from one animal species to another through inoculation.

Mucked-Up Cells

Because CJD, kuru, and scrapie have long incubation periods, many researchers theorize that the culprit may be an "unconventional" or "slow" virus—perhaps a viruslike nucleic acid, which would explain how the agent replicates itself. But neurologist Stanley Prusiner at the University of California at San Francisco has sparked controversy by suggesting that the lethal trigger may actually be abnormal PrP alone.

To distinguish the substance that causes these diseases from common viruses, Prusiner has coined the term "prion"—proteinaceous infectious particle. He thinks the prion may be abnormal PrP without any nucleic acid, leaving in question how it reproduces itself.

The core of this hypothesis, says microbiologist David Kingsbury of the George Washington Medical Center, is that when a prion comes into contact with its cell counterpart, it leads to changes in the normal substance. Presumably, the immune system can't defend the cell because it doesn't see the difference between abnormal and normal molecules. The invading PrP accumulates and "mucks up the cell somehow."

According to Kingsbury, CJD's long incubation period could mean that "it takes a while for the lethal molecule to target the right cell, and then it takes a while for the conversions to go on." If indeed such protein mechanisms are part of long-term degenerative diseases like CJD and Alzheimer's, explaining the processes involved could help researchers understand aging.

But Paul Brown believes that Prusiner and others have "far from proved that the protein itself" is both sufficient and necessary to spark CJD. Like many microbiologists, Brown finds the term "prion" loaded because it implies that the protein's ability to invade a cell and reproduce is proven. Thus, he uses only more general terms like slow or unconventional virus.

In response, Jeffrey Bockman, a colleague of Kingsbury, points to a lack of evidence that the modified protein is merely a symptom of CJD. Critics like Brown, he says, haven't shown that "there is a normal virus lurking around that just hasn't been discovered yet."

The New York institute's Bolton, who thinks the prion theory has merit, says scientists know for certain only "that somehow, something happens in certain cells of the brain when you introduce the agent, causing the normal protein to change." In his opinion, this biological riddle "may have important implications, not only for these relatively rare diseases, or in Alzheimer's and aging, but also in other areas that we don't understand." ■

THOMAS KIELY is a frequent contributor to Trends, specializing in business and medical issues.

Science Soaps

Throughout the Third World, innovative uses of mass communications are bringing scientific, technical, and social messages to audiences that regular media fail to reach. From soap operas to festive "science marches," these unconventional approaches mark a realization that the best ideas can falter if people don't get the word.

In India, several populist organizations blend tradition and modern science to actively promote alternative views of economic development. The oldest and largest effort is the Kerala Shastra Sahitya Parishad (KSSP) in southeastern India. Founded in 1962 by a small band of science educators and writers, the KSSP initially aimed only to distribute inexpensive books and magazines. But as members converged on the KSSP's annual conference in 1972, several groups of them gave impromptu lectures on science and society at schools, cultural centers, and markets along the way.

The success of this *jatha,* or science march, encouraged KSSP to send 300 volunteer teachers and scientists into the countryside the next year to give over 1,000 presentations. The *jathas* continued, joined by more formal presentations in larger cities, and by the 1980s, the "people's science" concept became a phenomenon. Now jugglers, acrobats, and actors often accompany the caravans of scientists and teachers, regularly bringing science-cum-festivals to scores of Indian villages. In 1987, a four-pronged, month-long march to Bhopal on the third anniversary of the disaster there provided a nationwide warning on the hazards of unrestrained industrialization.

The private and diverse nature of the *jatha* movement makes evaluating its impact difficult. In Nepal, however, feedback is built into a program to popularize science.

Four years ago, the Royal Nepal Academy of Sciences began to enhance science communication as part of a broad national development strategy. The project trains young science journalists and distributes free features to newspapers and magazines, but it recognizes that radio is better suited to reaching a population that is 90 percent rural and 33 percent literate. As a result, every week Radio Nepal broadcasts a lively mix of general science news, practical technology, and interviews with experts to isolated mountain valleys. Once a month, the program includes a review quiz. The prizes are science materials, and listeners mail in over 300 responses each month, providing a measure of both the show's signal strength and its effectiveness.

Box-Office Hits

Nepal has only begun to add TV to the project, since its fledgling system airs just three hours daily. By contrast, Indonesia combines video technology with traditional folk drama to pursue a variety of goals, including expanding the public knowledge of science and technology.

The medium is an element from the shadow play, or *wayanq kulit.* In the hands of a skilled *dalanq,* or puppeteer-storyteller, this ancient sound-and-light show is a vehicle for expressions of religious belief, ethnic culture,

and national identity. Although the plays have been strictly codified through centuries, the *dalanq* can stray from the story to introduce contemporary topics and local personalities.

Recognizing the potential of these dramas, the Ministry of Information created *Ria Jenaka,* a weekly TV program with live actors portraying the puppets from a familiar comic sequence. Broadcast Sunday mornings, each 15-minute sketch develops a theme such as family planning or better sanitation. Marked by broad humor, coarse language, and simple plots, the programs appeal to general audiences.

Similarly, Mexico has adapted a familiar TV format to good purpose. From 1977 to 1982, Mexico's major private network produced soap operas that competed with commercial fare while also addressing social problems. Featuring well-known stars, the programs dealt with issues that Mexican television had previously ignored — illiteracy, child abuse, rural emigration, the oppression of women, birth control. Seven series appeared, with about 150 episodes in each. Following every episode, viewers could contact relevant government offices for more information.

When the popular actress Sylvia Derbez played a rural teacher, nearly a million Mexican adults signed up for an education course promoted by the series, double the previous number. After a series stressed child care and birth control, a half-million women joined family-planning programs for the first time—a one-third increase. And when Derbez discreetly displayed an IUD on-screen, contraceptives sales rose 20 to 25 percent.

The Mexican experiment with social soaps has continued on the government-owned Imevision, with a nationally broadcast 26-part sitcom highlighting sexuality issues. Supported by the U.N. Fund for Population Activities and private producers, *Las Buenas Costumbres* ("Polite Society") follows the careers of four doctors and their wives. Through the contrasting lifestyles of these people, the show examines family planning, unwanted pregnancies, myths about contraception, and sexual double standards in marriage and on the job.

The same group has produced a feature-length movie, released in Mexico last year. Ostensibly a comedy about a young professional couple unable to conceive a child, "Let's Try It Again" deals realistically with temporary sterility, perinatal death, and unplanned teenage pregnancy. The film has received great reviews, and, more important, it has been a box-office success. ■

JAMES CORNELL is president of the International Science Writers Association.

Many Third World nations are blending tradition and popular entertainment with modern technology to convey scientific and social messages.

ILLUSTRATION: JON McINTOSH

Measuring the Quality of Life

Economists agree. Their most treasured numbers obscure reality. Even the Gross National Product (GNP) and the federal deficit ignore such critical facts as homelessness, the depletion of natural resources, and women's unpaid labor.

Perhaps the best known revisionist is Robert Eisner, 1988 president of the American Economics Association, who denies that the federal deficit is "our number-one economic problem." According to Eisner, last year's $155 billion deficit might disappear if the government did its accounting the way corporations do. For example, corrected for inflation, the deficit drops by $92 billion. And if investments in roads, schools, and the rest of the infrastructure are counted as assets that can be depreciated, $70 billion more vanishes.

Defying the chorus of budget cutters, Eisner says "deficit reduction that curbs our investment in human capital is the greatest folly of all." He insists that how the government spends money is more important than the deficits themselves. Writing in the conservative *National Review,* this liberal notes, "Our really huge deficits were a major factor in the sustained recovery from deep recession." Moreover, the future depends on public investment in infrastructure and "in our resources of land, air, and water, and in research and in the health and education of our people."

A commission led by Norway's Gro Brundtland recognized that ecology and economics are interwoven.

Deficits notwithstanding, most critics take aim at the fidelity of the public, press, government, and financial markets to the notion that GNP is *the* measure of economic health. Jonathan Porritt, a founder of England's Ecology Party, notes that GNP doesn't indicate whether growth can be sustained. In the *New Internationalist,* he writes, "The single-minded pursuit of economic growth, as measured by . . . GNP, has undermined the livelihood of millions."

According to World Bank economist Salah El Serafy, GNP is an especially poor yardstick in economies based on natural resources. "When the bonanza ends and the natural resource is almost exhausted, standards of living have to fall."

But what could work better? Since 1973, when economists William Nordhaus and James Tobin pioneered the idea of measuring economic welfare, researchers have tried to quantify that abstract concept. One catalyst was the 1979 publication of the "physical quality of life index"—the PQLI—put together by the Overseas Development Council. Noting that GNP "is unable to show how output is distributed among people in poor (or even rich) countries," ODC researcher Morris Morris combined infant mortality, life expectancy, and basic literacy to produce this crude index.

Environmental Accounting

While indicators like the PQLI are unlikely to guide U.S. policy soon, several global organizations already consider such factors when grading the success—especially the sustainability—of economic development. Two years ago, the Brundtland Commission, an independent U.N. body, declared, "We are now forced to concern ourselves with the impacts of ecological stress—degradation of soils, water regimes, atmosphere, and forests—upon our economic prospects."

In its final report, *Our Common Future,* the commission concluded, "Ecology and economy are being ever more interwoven . . . into a seamless web of causes and effects." The U.N. had selected Norway's Prime Minister Gro Brundtland to lead the study in part because she is the only head of state to have also been an environmental minister.

Several European governments have taken the lead in considering the connection between the environment and economics. For example, Jacques Theys of the French Ministry of the Environment explains how his nation's "patrimony accounts" have begun to "incorporate the environment more effectively in economic policy." This broad system is designed to help preserve natural resources and "those with a historical or cultural value."

A driving force behind "resource accounting" is a joint effort of the World Bank and the United Nations Environment Programme, whose objective is to overhaul the U.N.'s standard system of national accounts (SNA) by 1991. Most nations closely follow this model to gauge the state of their economies. By giving more weight to environmental factors than does the present system, the revised SNA will be geared primarily to the Third World, where short-term pressure to exploit resources jeopardizes long-term survival.

The project has focused on technical obstacles to revising the SNA, such as placing a dollar value on untapped oil or forests. This is exceedingly difficult, in part because the worth of the resources varies. While investigators have made progress, "much empirical work must still be done," say Serafy and his World Bank colleague Ernst Lutz. Thus, they suggest adding auxiliary environmental accounts to the SNA.

However, *Wasting Assets,* a just-published World Resources Institute (WRI) study, notes that technical shortcomings also mar traditional measures. Further, few nations adopt the SNA's supplementary tables. Thus, WRI's Robert Repetto says it's time to bring environmental factors into the main national accounts. Only then, he thinks, "will the economic losses associated with environmental degradation be taken seriously." ■

MARC S. MILLER is a senior editor of Technology Review.

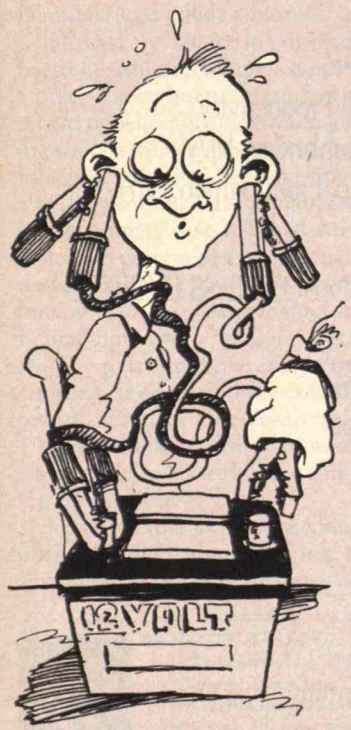
When countries like Madagascar clear land for farming, they could jeopardize future growth.

PHOTOS: THE ROYAL NORWEGIAN EMBASSY; WALT ANDERSON/TOM STACK AND ASSOCIATES

ANXIETY MAPS

Scientists at Washington University in St. Louis have located what may be the seat of fear and anxiety in the human mind. Anticipatory anxiety appears to be associated with the temporal poles—the tips of the temporal lobes inside the temples and behind the eyes. This marks the first time that scientists have connected specific parts of the human brain to a normal emotion.

For the research, Eric Reiman, Marcus Raichle, Peter Fox, and Maureen Fusselman had to induce anxiety in volunteers during a 40-second positron emission tomography (PET) scan. They chose a time-tested method: the expectation of a painful electric shock. To maintain the credibility of the experiment, they did, in fact, administer a shock to each subject after a PET scan. However, it was calculated to produce only mild discomfort.



JOYCE DECIPHERED

Computers are helping meet the challenges posed by James Joyce, including his irreverence for conventional punctuation and spelling, his propensity for coining words and borrowing from as many as 40 languages, and the lack of definitive editions of his works.

Drexel University humanities professor Michael O'Shea believes computers could prove invaluable in helping scholars appreciate Joyce's love of word play, revolutionary artistry in language, and vast vocabulary. Using software designed for manipulating and analyzing literary texts, O'Shea looks at both the frequency with which given words occur and their context.

O'Shea and others are also exploring the possibility that computers could maintain and organize bibliographies of critical resources: the volume of scholarship on Joyce is second only to that on Shakespeare, totaling 12,000 to 15,000 books, articles, and other materials. Compact discs might provide convenient access to the entire body of criticism, as well as definitive electronic versions of Joyce's fiction.

POLLUTION COMPUTER

Two Carnegie Mellon scientists armed with a supercomputer helped shape the stiff new pollution law recently adopted in the Los Angeles area. Using a Cray X-MP at the Pittsburgh Supercomputing Center, Gregory McRae and Ted Russell modeled the atmospheric events that cause air pollution. From this data, they suggested cost-effective strategies to control the pollution.

California is already implementing one of their proposals, substituting methanol for gasoline in public vehicles. A second idea focuses on controlling nitrogen-oxide particulates. Next, says McRae, the center's new Cray Y-MP, three times more powerful than its predecessor, will let him and his colleague analyze climate problems across the entire country. They could even model global climate.

WORKER POWER

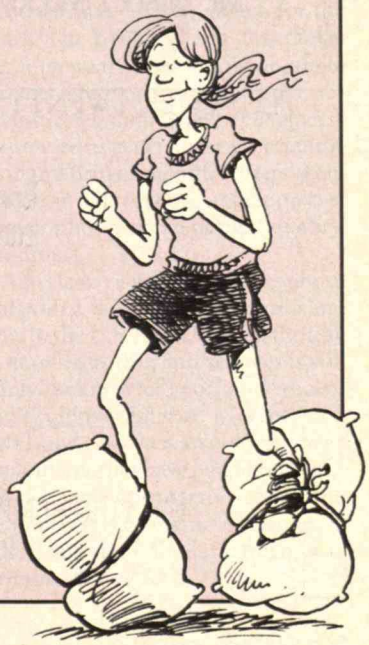
To maximize profits and improve the mental well-being of their employees, companies should democratize work environments, according to Robert Sipe, professor of labor relations at Sangamon State University in Illinois. Firms should give workers equal power and participation in decision making. Group leaders should be responsible to the groups, rather than the other way around. "Workplace democracy is the future," Sipe told the Worker in Transition Conference of the American Society of Mechanical Engineers.

Sipe notes that workers are concerned about how automation will affect their lives. "This technology can either displace the human presence . . . or it can 'informate' and expand the creative capacities of workers. If one is to choose the latter, a new organizational structure is needed that empowers workers with more job control and decision latitude."

JOGGER TURF

If you jog, an asphalt track will give you the greatest shock. Plush grass causes the least stress, but imperfections like divots or holes make it a poorer surface than polyurethane tracks. That news should interest the 40 million Americans who will participate in some form of running this year. Between 50 percent and 70 percent of these runners will suffer an injury.

To determine the surface that causes the fewest injuries, Lehigh University biomechanics experts measured the shock to the lower joints of a 22-year-old runner who averages 15 to 20 miles a week. The scientists found that artificial tracks provide a relatively good shock-absorbing alternative to asphalt. And unlike grass, such surfaces pose little danger of twisted or sprained ankles.



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BENNETT HARRISON

Fail Britannia?

To hear the Thatcher government, City of London financiers, and journalists tell it, British manufacturing has done quite nicely during the post-1983 recovery. Corporations are assimilating new computerized technologies and Japanese-influenced just-in-time inventory practices. Manufacturing productivity has been rising since 1983 at the healthy annual pace of more than 4 percent.

But during a stint in Britain last spring as a visiting fellow of Balliol College at Oxford University, I met plenty of engineers, production managers, and economists who were far less sanguine. They thought that efforts to make British-owned factories more flexible and efficient were alarmingly half-hearted. And some recent data suggest that the critics are right to be worried.

Despite relatively high productivity, 1989 manufacturing output has only just caught up to 1979 levels, and it is still a good 10 percent below what it was in 1973. The stock of capital equipment in British industry continues to grow at the anemic annual rate of 1 percent—right where it was in the 1970s. According to Cardiff Business School professor Barry Wilkinson, purchases of flexible manufacturing systems—one measure of technological modernization—have fallen off sharply. Meanwhile, the trade deficit in manufactured goods continues to rise.

If things are bad for major British industries, the situation for their suppliers is even worse. Component manufacturers still record unbelievably long waiting times during which semi-finished products sit idle before proceeding to the next operation. In 1985, fewer than half the plants sampled in one comprehensive national survey could deliver 75 percent of their products on time, and one in four plants were late more often than not. And some companies still haven't figured out how to minimize wasted movement of parts from one area of the plant to another. As one corporate executive admitted in the press, "We discovered that one 50-pence [about $.80] component was traveling 15 miles within the company during production."

So what explains those seemingly enviable productivity numbers? First, remember that plant shutdowns and layoffs eliminated 1.4 million jobs between 1979 and 1987—nearly 6 percent of the employment base. Against that background, economists such as David Metcalf of the London School of Economics attribute rising productivity mainly to a combination of work intensification—the traditional management strategy of "speedup"—and workers' fears of unemployment, spurred by the last recession. This is not a stable foundation for long-term economic growth.

There's less to Britain's economic recovery than meets the eye.

Another sign that the British recovery may not last is the continuing sorry state of British engineering education. Everyone agrees about the nature of the problem: too few engineering graduates, even fewer of quality, with not enough interested in manufacturing and too many moving into finance. In 1977, the last Labour government established a prestigious Committee of Inquiry into the Engineering Profession to address these problems. The committee, headed by prominent British industrialist Sir Montague Finniston, examined the education and licensing of engineers in the U.K. and how it related to the deteriorating international competitiveness of British manufacturing.

The new Conservative government released the Finniston report, *Engineering Our Future,* in early 1980. Much like the recent study of the MIT Commission on Industrial Productivity, the report argued that a vital manufacturing sector is crucial to a healthy economy. The engineers, academics, trade unionists, and businesspeople who made up the committee concluded that elementary and secondary schools didn't teach enough science and math, and that university-trained engineers were not getting enough experience on the shop floor. They recommended that companies develop apprenticeship programs for engineers still in school, and provide systematic training of newly hired graduates, at least during the first few years of employment.

Nine years later, there have been some improvements. An Engineering Council drawn from all the professional institutes (mechanical engineers, chemical engineers, etc.) is urging engineering faculty in the universities and polytechnic schools to place more emphasis on practical projects oriented toward industry needs. More students are getting American-style summer jobs in industry, some of which translate into regular employment after graduation. And the government has subsidized university programs for steering more students into engineering careers.

Yet when I talked with Oxford engineering don Alastair Howatson, he told me with more than a trace of resignation that perhaps half the students completing that university's undergraduate specialization in engineering, economics, and management are still taking jobs in finance. Apparently, the new incentives have been no match for the high salaries in banking and insurance. Moreover, nine years after Finniston, there is no agreement among the country's universities and institutes about whether engineers should be trained as generalists or specialists. And too many British manufacturers seem stuck in their rut of trying to compete on cost and volume rather than on design, quality, and promptness.

To an American visitor who thinks about industrial policy, it all sounded depressingly familiar. In the U.S., as in Britain, the link between manufacturing and services is still not widely acknowledged, and recent productivity gains seem soft. Moreover, efforts at MIT and elsewhere to point students toward manufacturing have had limited success. One can only hope that the recent campaign to improve U.S. manufacturing will bear more fruit than similar attempts in Great Britain. ■

BENNETT HARRISON, a professor in MIT's Department of Urban Studies and Planning, is currently a visiting professor at Carnegie-Mellon University in Pittsburgh. His most recent book, co-authored with Barry Bluestone, is The Great U-Turn, *published by Basic Books.*

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SAMUEL C. FLORMAN

Hegel and the Amazon Basin

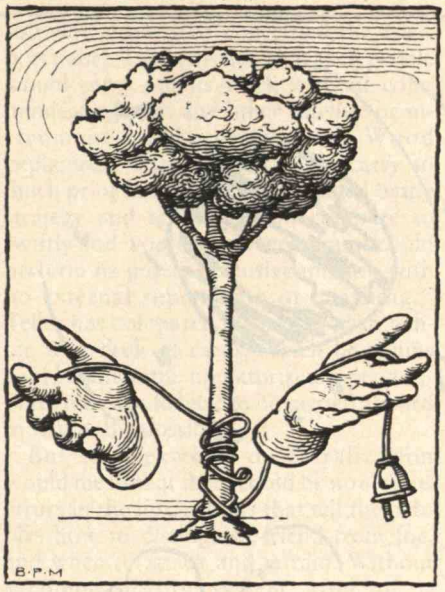
"The essentially tragic fact," wrote the philosopher Hegel, "is not so much the war of good with evil as the war of good with good." I thought of this remark recently in connection with the production of electric power in Brazil.

Lacking significant reserves of oil or coal, and plagued with chronic technical difficulties at its single nuclear plant, the Brazilian government has resolved to use hydroelectric dams to meet the nation's future energy needs. At first, this struck me as a splendid decision. According to the environmentalist literature I have seen, hydroelectric power is usually ecologically benign—much preferable to hydrocarbon fuels, which bring acid rain and worsen the greenhouse effect, and surely better than nuclear power, which gives us safety problems, radioactive waste, and large doses of political angst.

And where could it make more sense to exploit river resources than in Brazil, which contains a fifth of the world's fresh water? The Amazon runs 4,000 miles to the Atlantic Ocean, and at least 15 of its tributaries are more than 1,000 miles long. The state power monopoly has identified 136 prospective sites for new dams—more than half of them in the Amazon Basin—and at least 90 are already on the planning agenda.

Energy without environmental cost—it seems too good to be true. Unfortunately, it is. Complications arise because Brazil's thousands of miles of rivers run mostly through low-lying country. Building a dam invariably means flooding large areas of jungle. The Balbina Dam, for instance, built on the Uatuma River, submerged 900 square miles of jungle to produce only 250 megawatts, barely half enough for the needs of nearby Manaus. The recently completed Samuel Dam, on the Jamari River near Porto Velho, is somewhat more efficient, creating a lake of 200 square miles and producing 217 megawatts. But like the Balbina, it can't even meet local demand, much less contribute electricity to the far-off southern cities of Sao Paulo and Rio de Janeiro.

When considering the Amazon Basin, an area as large as the United States east of the Mississippi, many Brazilians see little reason to be concerned about flooding a few thousand square miles of jungle. "There is plenty of space," an engineer told a *New York Times* reporter during a boat ride last year on the Balbina Reservoir. "If one day we need the land, we can take away this dam."



Philosophy can shed light on questions that science alone can't answer.

Environmentalists in Brazil and around the world do not share this cavalier attitude. They see the gradual destruction of the Amazon Rain Forest as a disaster in the making. It could cause the extinction of thousands of plant and animal species and harm the global climate. (Since trees absorb carbon dioxide and emit oxygen, they are a countervailing force to the greenhouse effect.) There is already great concern about the burning of forest for agriculture and cattle raising, and about the spread of industrial development through the region. Flooding large areas to create power—which in turn is likely to attract even more development—only makes a bad situation worse.

In an effort to retard this process, organizations such as the Worldwatch Institute have called upon international creditors to cut off funds for new projects. Recently the World Bank responded by demanding environmental safeguards as a condition for processing a vital $500 million energy loan.

Brazilians resent being pressured in this way, particularly by citizens of developed nations that didn't let environmental niceties get in the way of exploiting *their* natural resources. Earlier this year, the Brazilian government, joined by the seven other nations of the Amazon Pact, denounced outside interference in the region's environmental affairs.

So the use of hydroelectric dams to meet Brazil's energy needs—which at first reading seemed an ideal solution to a serious problem—confronts us with new difficulties, not only in environmental policy but also in our relations with the Third World. Adding to the urgency of the problem is the fact that over the next 20 years Brazil's population is expected to grow from 140 million to more than 200 million. A dreadful dilemma indeed, the tragic war of good with good.

In our no-nonsense age of science and technology one rarely seeks practical solutions from philosophers. Still, science—which has solved many of the problems that long puzzled classical philosophers—has its limits. Systems analysis alone cannot tell us what to do about electric power in Brazil. Unless wisdom and sensitivity are brought to bear, the situation might escalate into an ominous political confrontation.

Of course, Hegel cannot help us or the Brazilians decide how many dams should be built in the Amazon Basin. But his vision of life as a process of coping with and reconciling "the strife of opposites"—in this case, economic development and environmental concerns—encourages us to look for workable compromises. Where the jungle is flooded for the sake of electric power, perhaps its destruction for other purposes should be limited by an equivalent amount. Surely, efforts to conserve the use of energy should be intensified. And Brazilians may even decide that the reckless industrialization of other nations need not serve as a model for their own development. Recent studies show that harvesting fruits, cocoa, and latex from the rain forests may be economically and socially more viable than large-scale clearing for other purposes.

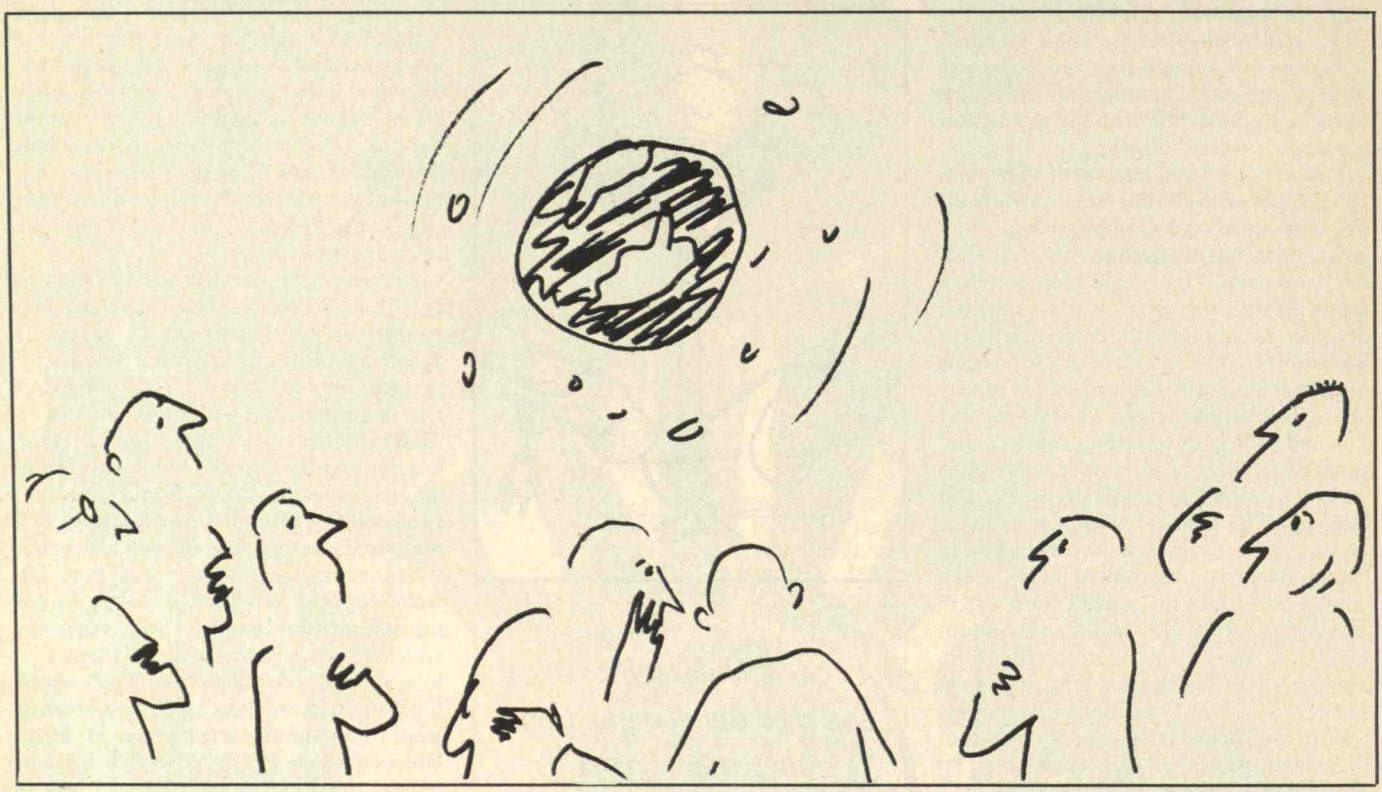
Making such decisions intelligently requires diplomacy as much as science and technology, and, yes, it requires philosophy as well. Like electric power in Brazil, our technological predicaments can be so confounding that they force us to stop in our tracks and reflect on who we are and what we really want. A little old-fashioned philosophizing may be just what we need. ■

SAMUEL C. FLORMAN, a civil engineer, is the author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, Blaming Technology, *and* The Civilized Engineer.

ILLUSTRATION: BRUCE MADDOCKS

BY JONATHAN JACKY

Throwing Stones at "Brilliant Pebbles"



THIS past April Defense Secretary Dick Cheney presented the House Armed Services Committee with a plan to revitalize the faltering Strategic Defense Initiative (SDI): "brilliant pebbles." Forming a constellation of small satellites that would girdle the earth, thousands of "pebbles," each guided by an onboard "brilliant" computer, could smash into enemy rockets.

The notion recalls some of the crazier space-weapons schemes from the past. In the late 1950s, Livermore scientists proposed detonating thousands of nuclear bombs in space each year to encircle the earth in a belt of high-energy electrons that would destroy enemy missiles. Fortunately, wiser heads realized that the idea could irreversibly ruin outer space for communications, surveillance, scientific research, and manned exploration.

JONATHAN JACKY, a research assistant professor in the Department of Radiation Oncology at the University of Washington Medical School, works on computer control systems. He has contributed to Computers in Battle: Will They Work? *(Harcourt Brace Jovanovich: 1987) and was one of the first scientists to write about the problems with creating software for SDI.*

The latest scheme for the Strategic Defense Initiative could have even more technical problems than past proposals.

"Pebbles" proponents have adopted a political strategy that was proven when Star Wars was first launched: bypass the technical specialists and go directly to people who have important political access. Several such people have jumped on the brilliant pebbles concept as a bold new idea. Vice-President Dan Quayle has said the scheme "could revolutionize our thinking about strategic defense." And on PBS's political talk show "The McLaughlin Group," conservative commentator Pat Buchanan has called the idea the best policy initiative of the Bush administration.

Many scientists, including some within the Pentagon, are more skeptical. In fact, the pebbles are vulnerable to many of the same countermeasures as earlier SDI proposals. And because thousands of units would act almost independently of control from the ground, they could place even tougher requirements on computer software. Although the various proponents have not been forthcoming with many details about the pebbles plan, Congress and the Defense Department need to recognize the technological barriers now. By the end of this year Congress will decide how much funding SDI should receive next year—and it could waste money if it buys into this latest poorly conceived concept.

Autonomous Supercomputers

When Cheney spoke about the brilliant pebbles plan this past spring, SDI was badly in need of a boost. In the six years since Ronald Reagan rallied support for the idea of a defensive space shield, one Star Wars concept after another has become tarnished. The initial interest in weapons employing lasers and other beams to shoot down Soviet intercontinental ballistic missiles faded after a 1987 study by the American Physical Society

ILLUSTRATION: TAMAR HABER-SCHAIM

concluded that the idea was impractical for the foreseeable future. Subsequent enthusiasm for orbiting kinetic-energy weapons—which would destroy missiles by smashing into them—cooled after a 1988 report by the congressional Office of Technology Assessment (OTA). That study found that these weapons would cost too much to deploy in great enough numbers to blunt an attack, and that a variety of comparatively cheap countermeasures could defeat them.

Other critics focused on the unprecedented software requirements for highly automated space battles. When the SDI Organization (SDIO) convened the Eastport panel to study the software problem in 1985, one panelist resigned, arguing that the problem was insoluble. Other panelists called for a decentralized software design—one with minimal communication among the parts—so that the complete system would not go down because of a failure at one location, and to minimize communication problems. SDIO disputed the critical findings, but their cumulative effect was to limit SDI spending by Congress to about $4 billion per year—far less than needed to deploy a system.

Nevertheless, Reagan's vision of a comprehensive missile shield remains politically potent. It is especially dear to those on the Right, and to those who believe that despite technical problems, a highly visible SDI program encourages the Soviets to be more accommodating at the bargaining table. This large and influential constituency assures continued demand for anti-missile plans. But the conflict between political interests and technical realities poses a knotty problem: how to pursue Star Wars without funding a largely discredited weapons scheme.

Enter brilliant pebbles. The scheme was first unveiled more than a year ago by the controversial Livermore Laboratory weapons scientist Lowell Wood at SDI's "fifth birthday party" in March 1988. (Wood, head of the group that invented the x-ray laser weapon, once suggested implanting miniaturized supercomputers in living human brains. Wood said these "silicon-human hybrids" would become commonplace in the 1990s and supersede the human race over the next century.) Wood presented the pebbles concept in its purest form: perhaps 100,000 autonomous orbiting weapons.

Wood and his mentor, Edward Teller, are focusing on autonomy to address the software issues that concerned the Eastport panel. They envision that each pebble would carry out its work without communicating with any other satellite or instrument on the ground. As Wood explained, "Each pebble would carry so much prior knowledge and detailed battle strategy and tactics, would compute so swiftly and would see so well that it could perform its purely defensive mission with no external supervision or coaching." Teller has compared the size of each pebble to a deck of cards, which he claims could contain the miniaturized supercomputer that would have to be carried aboard to make this possible.

But such extreme decentralization would mean that there could be no serious errors in the instructions that tell the pebbles how to distinguish friend from foe, and when to attack and refrain. Without a communication system, after all, it would be impossible to reprogram the pebbles in orbit.

Apparently aware of this difficulty, this past February—just before his retirement—SDIO director General James Abrahamson presented a toned-down version of the pebbles plan. In an internal memo, Abrahamson said that "individual interceptors would not be activated until a human being has confirmed that a real attack is under way." The activation orders would be relayed through a network of communication satellites. In other words, the pebbles would rely on a more centralized design—which brings back the possibility that a failure would bring down the communication system or that an opponent could interfere with it.

Abrahamson discussed a much lower number of pebbles—"several" thousand. He also proposed that the pebbles would be housed until needed in protective "cocoons," increasing the weight that would have to be orbited. To address concerns that the numerous pebbles might collide with friendly vehicles in space, he said the weapons might be grouped in "racks." But for an opponent that could mean both fewer, larger targets and a better chance of guiding missiles through gaps among the racks.

(While Abrahamson's document does not describe the pebbles' appearance in detail, last April the SDIO indicated to the *New York Times* that they would be torpedo-shaped objects about three feet long, each weighing about 100 pounds. Most of the mass would be taken up with rocket fuel.)

The most startling item in Abrahamson's memo is the price tag for the pebbles scheme. He estimated that a complete pebbles defense could be deployed for about $25 billion, a cost that, he wrote, would make SDI deployment "more affordable." In contrast, the pre-pebbles "Phase I" deployment plan favored by the SDIO (which would not have employed exotic beam weapons) was estimated by proponents to cost about $100 billion, and by the 1988 OTA study about $200 billion. Abrahamson's estimate is much lower than the cost of several strategic-weapons programs under way, such as the MX missile.

But Abramson's figure is not credible. The memo gives no clues about how the estimate was derived. It apparently ignores the costs of many of the required components. And no one can accurately estimate the cost of deploying a technology for which scientific issues remain to be solved.

Heading After the Wrong Targets?

There are several other potential scientific problems with the brilliant pebbles schemes. Any glitches that do crop up could affect a significant number of pebbles. Hardware failures or software errors might render the devices inert and useless, turning them into nothing but an expensive belt of orbital debris. Or, like the sorcerer's apprentice, pebble-builders might erroneously program these servants to home in on the wrong targets. And once in orbit they would remain there for many years. Even if the pebbles were controlled from the ground, they would be nearly impossible to eliminate if contact with them were lost in the event of failures in the communication system.

The pebbles would also remain vulnerable to many of the physical countermeasures that dogged their forebears. An attacker might use fast-burning, low-flying rockets that could sneak under the pebbles. Or an opponent might punch a hole in the pebble belt with a few nuclear bombs that would explode in space, blinding the pebbles' opto-electronic eyes and scrambling their brains with neutrons and electromagnetic pulse.

Because of these potential problems, Congress and the Department of Defense need to carefully investigate the brilliant-

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BY STEPHANIE POLLACK

Solving the Lead Dilemma

Stricter regulations are the key to developing better ways to protect children from lead paint in homes.

When Ray Spells was two, his mother took him to a clinic in New Orleans' St. Thomas public-housing development for a checkup. The result was routine for St. Thomas preschoolers: like two of his three siblings, Ray had lead poisoning. He has since been hospitalized 19 times for therapy that helps his body excrete lead.

A few square blocks of three-story brick buildings, St. Thomas opened in the 1930s. Lead paint was used inside apartments and outside on screen doors, porch railings, and the delicate grillwork that gives the project a classy air. Half a century later, the Spellses and dozens of other families are suing the New Orleans Housing Authority. Because lead can permanently damage a child's central nervous system, they want the agency to help pay for extensive medical treatment and for educational and occupational assistance.

Ray Spells is typical of those who come to mind when most people think of lead poisoning: black children in dilapidated housing. Indeed, racial and economic factors cannot be ignored. An estimated 8 to 11 percent of poor black children in inner cities have over 25 micrograms of lead per deciliter of blood, the level the Centers for Disease Control (CDC) defines as lead poisoning.

But the problem appears to be even more widespread. The Environmental Protection Agency (EPA) has concluded that damage occurs in children at 10 to 15 micrograms per deciliter. On the basis of these figures, Paul Mushak, an environmental pathologist at the University of North Carolina at Chapel Hill, concludes, "No socioeconomic or demographic category of young children [is] immune to lead's impact." Mushak is coauthor of a 1988 report to Congress by the Agency for Toxic Substances and Diseases, which estimates that 2.4 million preschool children in urban and suburban areas—17 percent of all such children—have blood lead levels over 15 micrograms per deciliter.

PHOTOS: SUSAN V. STEINKAMP HAND COLORING: CINDY PARDY

The Baltimore approach to deleading is costly but effective. Raymond Sutton, an abatement worker with City Builders, wears disposable overalls as he covers a heating vent to keep dust from getting in.

In fact, Mushak suggests that lead is a unique environmental toxin. He says there is virtually no margin of safety between the danger point and the median levels in the general population—about 7 micrograms per deciliter.

With today's better understanding of lead poisoning, the debate about launching a serious prevention effort has effectively ended. The question is not whether to remove lead paint from children's environments but how to identify and develop methods to detect and get rid of it that are safe and cost-effective.

Until recently, such technology was totally inadequate, while R&D on better methods was nonexistent. Today the pace is somewhat quicker, but it still lags far behind needs, and existing techniques either work poorly, lack documentation of their effectiveness, or cost too much for widespread use.

As a result, an estimated 3 million tons of lead remains in paint accessible to children, scattered among 25 to 40 million housing units. Michael Andry, New Orleans' director of special health programs, points out that lead paint covers 60 to 75 percent of his city's housing. Similarly, estimates based on the age of the housing stock suggest that 60 to 80 percent of the units in New York, Boston, Philadelphia, and Chicago are also contaminated.

Despite the magnitude of the problem, many property owners and some officials at the federal Department of Housing and Urban Development (HUD) and at local and state agencies are still slow to take action. They feel that strict regulations mandating preventive lead-paint removal should wait until safe and cost-effective detection and abatement methods have been proven. This is a classic chicken-and-egg problem: the private sector won't invest in developing better technology without a market, and regulators won't impose restrictions until the technology is on the market.

To break the technology-regulation circle, government must take the first step. Technology already developed under existing regulations can make homes safer. Tough federal and state action is needed to expand the market for improved, affordable techniques, thereby stimulating the required R&D.

STEPHANIE POLLACK is director of the Lead Poisoning Project at the Conservation Law Foundation in Boston. She has bachelor's degrees in both mechanical engineering and public policy from MIT and a law degree from Harvard. She authored recent amendments to the Massachusetts lead law and served as a member of the National Institute of Building Sciences project committee on lead-abatement guidelines.

The Disappearing Threshold

Concern about lead has grown as medical research has steadily lowered the proven danger point. One of the best understood environmental toxins, lead has been known for centuries to have ill effects on adults. Only around the turn of the century, however, did pediatricians begin to investigate its impact on children. They realized that high levels of lead could kill children and that survivors often suffered mental retardation.

During the 1960s and 1970s, a growing number of studies linked more moderate exposure with damage to blood, kidneys, and the central and peripheral nervous systems. In response, the federal government repeatedly dropped the level at which it recommended medical and environmental action, from 60 micrograms per deciliter in the early 1960s to 25 in 1985.

At the same time, the federal government banned most uses of lead paint in 1977, and in 1986 it banned lead pipe and solder in plumbing that carried potable water. Over 90 percent of the lead was removed from leaded gasoline between 1975 and 1986. And ongoing efforts by the Food and Drug Administration and industry are reducing the amount of the toxin in food from lead-soldered cans and other sources.

Abatement is much easier in unoccupied units. After the family has moved to temporary housing, work teams empty the unit as much as possible and cover appliances with plastic to keep out dust.

Because of such measures, combined with mass screening and intense public education, "the incidence of lead poisoning came down dramatically," according to Jane-Lin Fu, a longtime pediatric consultant to the Department of Health and Human Services. CDC statistics indicate that the incidence among children dropped from 6 to 8 percent in the 1970s to 1 to 2 percent in the mid-1980s.

Nevertheless, the most recent medical investigations—including studies following the development of children in Boston, Cincinnati, and Port Pirie, Australia—reveal that lead harms children and fetuses at blood lead levels far below the CDC poisoning standard. It interferes with vitamin D metabolism, neurological development, and the formation of heme used to make hemoglobin in blood. Researchers have discovered that even very small amounts of lead threaten *all* children. "Many of the critical toxic effects of lead act through mechanisms that do not have thresholds," says Environmental Defense Fund toxicologist Ellen Silbergeld.

Herbert Needleman, a professor of psychiatry at the University of Pittsburgh and a prominent lead researcher, notes that the danger point seems to depend on the quality of the research. The level at which problems are documented, he says, has "continued to go down as the studies have become more sensitive and better designed." Studies of children from before birth onward into early childhood have been designed to carefully track many potentially confounding variables and collect data on environmental lead exposure and blood levels. These prospective studies correlate exposure and effects much better than do retrospective studies relying on one-time blood lead levels, since blood is only a temporary storage site for lead and thus reflects only recent exposures.

Of particular concern is evidence that exposure to very low levels of lead in the womb and in early childhood can decrease intelligence, school performance, and attentional and language function. According to Needleman, epidemiological studies in at least nine countries have connected blood lead levels as low as 10 to 15 micrograms per deciliter to poor performance on intelligence tests. And toxicologist Silbergeld told the EPA in 1988 that "it can be stated as a matter of consensus" that such problems can arise even from levels of 6 micrograms per deciliter.

Not only is the damage severe but the American Academy of Pediatrics and others have concluded that it is permanent. Preschool children's central and peripheral nervous systems are at a critical stage of maturation, and their blood-brain barriers are poorly developed. Children are thus more susceptible to lead-induced neuropsychological damage. Treatments can reduce the amount of lead in their blood but do not reverse any existing damage.

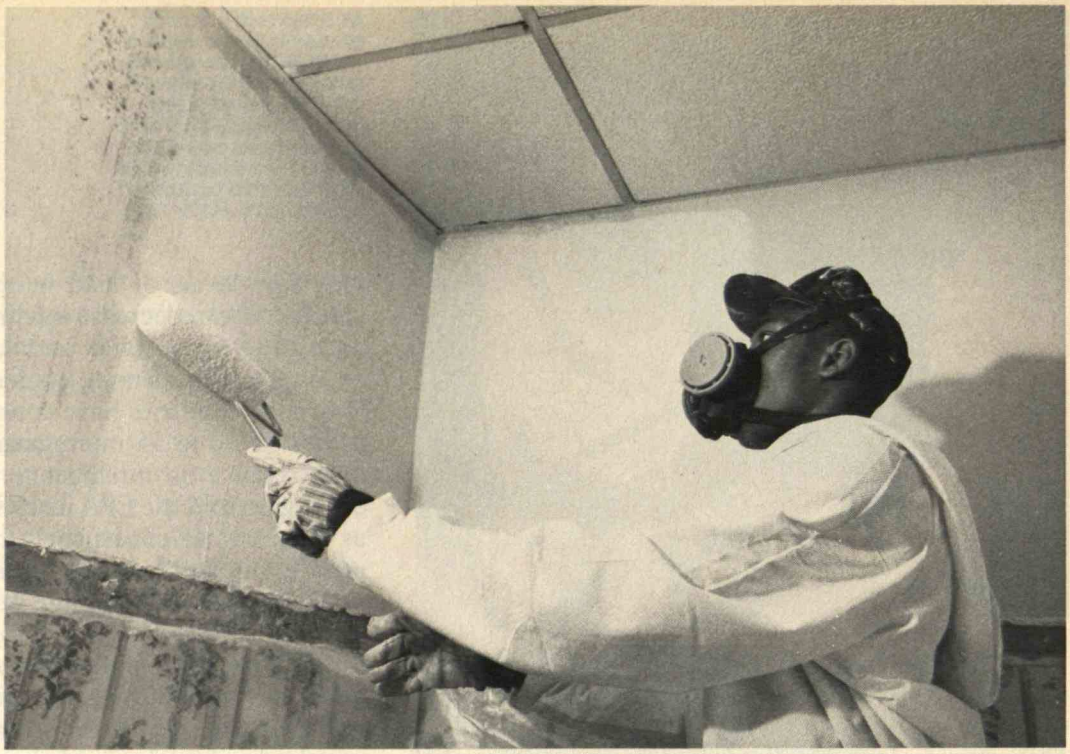
It is no wonder that lead poisoning now ranks near the top of public-health priorities. In the past two years, Connecticut, Maryland, and Massachusetts have enacted new or revised lead laws, and citizen groups and public-health advocates in cities like Chicago and Philadelphia are forcing local governments to respond. After more than a decade of silence since a wave of ordinances in the late 1970s, public interest and regulatory action are both reviving. These recent steps are based on the recognition that the only medically effective solution is to get children away from lead before harm can occur.

The Perils of Deleading

Acting on that recognition, however, has proven to be technically, economically, and politically difficult. By any measure, efforts to remove lead from the nation's housing have been inadequate.

In 1971, for example, Massachusetts passed one of the first U.S. laws mandating that property owners remove lead paint from apartments and houses in which preschool children live. But by 1987, fewer than 20,000 of the commonwealth's 1.2 million lead-painted units had been cleaned. According to a special commission, progress was stalled by lacks of awareness, enforcement, qualified contractors, and money. The commission concluded that at that rate, "we would see the housing stock fully deleaded around the year 2571."

Federal actions have been equally ineffective. The



City Builders' Jerome Branch encapsulates lead with a paintlike substance called Insulade. Bathrooms and kitchens are high-risk areas because they contain glossy paint, which used to contain a high level of lead.

Lead-Based Paint Poisoning Prevention Act of 1971 ordered HUD to "eliminate as far as practicable the hazards of lead-based paint poisoning" in public and federally subsidized housing. Concerned about costs, HUD issued regulations requiring only the removal of some peeling and chipped paint. Tenants of the Stanton Dwellings project in Washington, D.C., sued after a child was poisoned by intact paint on a window sill. In 1983, the district's federal appeals court found that HUD had been wrong to focus on cost-effectiveness and had failed to meet the act's mandate. The department was ordered to address more hazards, including intact paint, and to do a better job of monitoring compliance with the act.

Since that judgment, Congress, HUD, public-housing authorities, and health and housing advocates have been at odds on how and when to remove lead paint from public housing. Two sets of HUD regulations and three congressional enactments have failed to settle the question.

A primary reason for Congress's indecision—and for inaction by many state and local governments—is technological. The evidence is overwhelming that poor deleading won't prevent poisoning and can actually worsen contamination.

Traditionally, deleading has meant burning or sanding off all paint that is peeling and perhaps some that isn't. However, a 1985 Baltimore study found that 40 percent of lead-poisoned children sent home from the hospital to apartments cleaned this way had at least one recurrence of lead levels over 49 micrograms per deciliter within three months. Other studies have shown that burning and sanding spread large amounts of lead particles in the air.

In fact, while paint chips and painted surfaces remain the most important high-dose source of lead, the most common route of exposure—especially in cases of low-level poisoning—is household dust laced with lead from deteriorated or poorly rehabilitated surfaces. Young children easily inhale or swallow these dusts.

"We know one thing very clearly," says Mark Farfel, a public-health specialist at the Johns Hopkins Kennedy Institute in Baltimore. "Limited lead-paint abatement does not work. It has failed miserably." A primary reason is the crudeness of the techniques. "We're deleading exactly the same way they did at the turn of the century," complains the University of Pittsburgh's Needleman.

The Detection Dilemma

A similar backwardness mars efforts at detection. Here, says Farfel, "we're using 1960s technology."

Because most statutes don't require removing paint containing tiny amounts of lead, inspectors must establish if a painted surface violates the law. They can send samples to a laboratory, but this damages the surface and is slow and costly, requiring that inspectors return later to issue violation notices. Instead, inspectors rely mainly on two methods to detect lead-based paint on walls.

Portable x-ray fluorescence analyzers (XRFs) are the most common detectors. These hand-held devices use a radioactive source to stimulate fluorescent x-ray production by lead or other heavy elements; the machine is calibrated to detect these x-rays. However, XRF machines are costly ($8,000 to

Even within the limits of current technology, deleading can be done safely and effectively.

$10,000 each), expensive to maintain, and hard to operate consistently.

The biggest drawback is the XRF's inaccuracy at low levels. Regulations usually require removing lead at 0.7 to 1.2 milligrams per square centimeter of paint, once thought to be the lower limit of accurate detection. Regulators are now less confident. Below 2.0 milligrams per square centimeter, "the XRF is not reliable," says Susan Guyaux, head of the environmental section of Maryland's lead-poisoning prevention program.

To increase accuracy, both Guyaux and Stan Lewis, an XRF expert and a consultant to HUD, recommend that in close cases inspectors first scrape a surface down to bare wood to get a background reading. However, this procedure increases the length, and thus the cost, of inspections and thwarts the XRF's advantage of working without damaging a surface.

Clearly, one long-term solution would be improved XRF equipment, but for the time being some states and cities continue to use a chemical spot test based on sodium sulfide. Inspectors paint a solution of this chemical on a tiny cut made in the surface. The sodium sulfide turns black or dark gray when the lead concentration exceeds 0.5 percent, a common regulatory cut-off.

The biggest drawback is that readings are subjective. Different inspectors can interpret the same shade of gray as being either above or below the limit. Other metals in or under the paint can also cause a color change.

Regulators' faith in sodium sulfide varies widely. HUD doesn't allow it, believing XRFs to be more reliable. At the other extreme, Massachusetts allows public and private inspectors to use sodium sulfide as their sole detection method. Brad Prenney, director of the Massachusetts lead program, says this is because he foresees no better technology for the next few years. Other regulators, finding no approach wholly satisfactory, combine methods. In Maryland, Guyaux explains, "we take sodium sulfide"—which they use for screening—"we take a paint scraper, and we take an XRF every time we go out."

The Baltimore Model

Nevertheless, even within the limits of current technology, deleading can be conducted safely and effectively—if cost is not a factor. Baltimore is proof. Kennedy Institute and city and state officials, with some EPA funding, developed the "Baltimore method" over the past few years. It starts from the premise that partial rehabilitation—similar to what many owners of old dwellings would do in any case—works better than removing lead with traditional methods. Says Farfel, who heads lead-abatement field studies at the Kennedy Institute, "We have definitely demonstrated that we can leave a unit better off" using techniques like those applied in Darlene Henson's home.

In 1987, Henson noticed her daughter Dea, not yet two, standing at the window with something in her mouth. Henson took Dea to her pediatrician, who found the child had a moderate case of lead poisoning. Dea's blood lead returned to normal within six months without therapy, but Henson and her four daughters had to spend a month in a temporary shelter for families of lead-poisoned children while the city of Baltimore deleaded the house.

Jim McCabe, assistant director of City Builders, an agency that provides abatement services, explains that the process is "basically a carpentry job." His five crews of city employees spend three to four weeks at each vacated home of a lead-poisoned child.

Key to the Baltimore approach are numerous measures to protect workers and minimize the dust and contamination that rehabilitation generates. At the start, the work crew completely emptied the Hensons' four-bedroom row house, since "abatement goes much quicker in unoccupied units and cleanup is much simpler," Farfel explains. Workers wearing disposable coveralls and respirators protected the floors with plastic and sealed forced-air heating ducts. "We're talking about taking care from the very beginning to the very end," says McCabe. "If you don't, you can never get it clean."

Abatement crews replaced the woodwork around the windows in the home, and they installed vinyl-clad aluminum windows throughout to replace wooden windows painted with lead paint. Workers also replaced lead-painted baseboards and removed lead paint from the stair railing with a chemical stripper. In addition, to enclose lead paint, the crew caulked the outsides of windows and door jambs and wrapped them with aluminum. (That last idea came from a worker who used to install aluminum siding.)

After the construction workers had finished, a cleaning crew carefully removed debris and the plas-

Regular cleanup is important. Sutton sprays water on dirt and debris, then sweeps up every day. This helps keep the dust levels down, protecting the workers and easing the final cleanup.

tic that had protected surfaces. Most new woodwork was primed, and window sills received high-gloss paint to make cleaning easier. Workers mopped all surfaces with trisodium phosphate, which picks up lead well. They then cleaned the surfaces with high-efficiency particulate air vacuums and remopped them. Floors were painted with polyurethane to seal in any remaining lead dust and make future cleaning easier.

The last step was dust monitoring. City officials took samples of dust from floors, window sills, and window wells. Families can't move back until tests show that the dust is safe. If the dust contains too much lead—the limits range from 200 micrograms per square foot on floors to 800 in window wells—the unit must be recleaned. According to Farfel, state officials have deemed those thresholds "achievable and desirable."

One strong point of the Baltimore approach is that it includes all painted surfaces rather than just those that children chew on. "In a home in deteriorated condition, parents can't cope with the amount of lead dust," Farfel explains. Thus the emphasis is on long-term control. "That's why we adopted an approach to upgrade the surfaces so at least they would be smooth and cleanable."

Farfel notes that many of the steps taken in this approach, such as replacing windows and treating floors and walls, would be part of any modernization. Additional costs stem from temporary housing for the family, special worker preparation, containment, cleanup, and monitoring.

Incorporating abatement into large rehabilitation projects makes sense because abatement for its own sake with the Baltimore method is costly—usually from $6,000 to $10,000. For the Henson's row house and other properties in poor repair, "it is not unusual for abatement to cost more than the house," admits City Builders' McCabe.

The Cost-Quantity Trade-Off

Such hefty price tags have led to concerns that any technology that drives up costs—including the Baltimore method—is likely to reduce the number of units that will be cleaned. "If we focus on minimizing lead dust in individual units, we will produce a small number of pristine homes but leave millions in unacceptable condition," argues Needleman of the University of Pittsburgh.

This cost-quantity trade-off creates a dilemma for advocates of lead-poisoning prevention, who find themselves arguing that the most intensive health-protection measures should not be required. Needleman and 23 other prominent lead researchers and public-health officials wrote to HUD secretary Jack Kemp in January, urging him not to require unnecessarily expensive "Cadillac" abatements in public housing.

Many lead experts are convinced that abatement need not be as intensive as in Baltimore to produce safer homes for children. "We do not have to remove

Left: In the first major cleanup stage, workers remove dust from floors with a special vacuum, then apply trisodium phosphate—TSP—to pick up more lead. Here, after the floor has been vacuumed a second time, Michael Mosby is painting it with polyurethane.

Below: In the second cleanup stage, abatement supervisor Diane Scovens is going through the rooms again with the vacuum cleaner. This is followed by another TSP treatment and yet another vacuuming.

The final step is dust sampling to make sure the home is ready to be occupied. Project supervisor Susan Kleinhammer uses baby wipes to take samples from floors, window sills, and window wells.

every last microgram of lead to reduce children's exposure," says Needleman. Traditional methods, which focus on removing paint rather than replacing or encapsulating surfaces, "are being convicted of guilt by association with unsafe practices such as open burning of paint in occupied apartments," he insists.

There seems to be agreement that some elements of the Baltimore approach must be adopted. The consensus is that occupants should be moved out of units being abated, workers must wear respirators and have their blood lead levels monitored closely, and abated units must be cleaned to meet standards for residual dust. The question is, given these precautions, can paint simply be removed without going to the extent of partially rehabilitating a home?

Prenney, of the Massachusetts program, argues that partial rehabilitation "is not sufficiently sensitive to the issues of cost or practicality" for a state that mandates deleading of all units housing preschool children. Skilled laborers, such as carpenters, are expensive and in short supply in Massachusetts, and many homes require costly exterior deleading. Moreover, Baltimore generally has not had to deal with walls, because most homes there contain lead paint only on trim and windows; interior walls are usually wallpapered, and exteriors are stone or brick.

Prenney sees no alternative to traditional methods, albeit with added precautions for worker protection, containment, and cleanup. He is convinced that "given proper controls, dry scraping can be done, workers protected, and occupants returned to a safe house." Needleman agrees.

Farfel and others counter that there is no evidence that removal techniques can reduce residual dust levels as effectively as partial rehabilitation. Only in Baltimore, they note, has data on worker blood lead levels and residual dust been systematically collected.

But even Baltimore and Maryland have not yet decided under what circumstances property owners should be required to abate lead-paint hazards using the mandated method. Currently, McCabe's teams handle only 50 or so units a year, under a state-funded loan program for property owners. He is painfully aware that 50 homes "is just a drop in the bucket" compared to the 190,000 Baltimore housing units believed to have lead-paint violations. And Maryland's Guyaux admits that "at $10,000 a house, you aren't going to get too many houses done."

The Promise of Encapsulation

A cheaper way to remove lead effectively would partially overcome the cost-quantity trade-off. The strongest alternative is encapsulation, an approach that leaves paint on walls and some woodwork but prevents lead dust from escaping.

Traditionally, encapsulation has used paneling or dry wall inside a home and siding on the outside. In essence, these partially rehabilitate a home, with the same problems of cost and the need for skilled labor. Simply adding a coat of non-lead paint was rejected long ago, since the underlying lead paint would be exposed when the new layer began to chip or peel.

A number of new encapsulation technologies are

Federal, state, and local officials eagerly await new lead-abatement technology.

now being tested or used experimentally. Some employ different kinds of materials to cover a wall the same way paneling would, including flexible materials, such as fiberglass. Baltimore crews, for example, wrap lead-painted pipes with a material originally designed to make casts for broken bones.

No one is yet sure how much these techniques could reduce costs. But they could prove cheaper than partial rehabilitation for at least two reasons. First, encapsulation requires less labor—particularly skilled carpentry. McCabe notes that "with encapsulation you don't have to pull woodwork off and do repairs behind it." Second, encapsulation creates far less dust and debris and thus lowers cleanup costs and the need for safety precautions.

But many uncertainties must be addressed before encapsulation is generally accepted, so Massachusetts, Maryland, and the National Institute of Building Sciences are all evaluating the process. Massachusetts lead-program director Prenney believes that one drawback is aesthetic: because many of the coverings look like painted ace bandages, the current methods may appeal only to owners of rental properties forced to act by regulators. The Massachusetts program is also studying such issues as how long the coverings last, their effects on rot and underlying moisture, and occupational hazards during installation.

If encapsulation proves acceptable on a wide scale, it could be used in conjunction with partial rehabilitation, improving the cost-quantity balance. Savings would be particularly large if fewer precautions were needed. "If we could come up with an easy and quick way of encapsulating lead paint that was permanent," says Guyaux, "it would turn the whole issue around."

Closing the Technology Gap

With tens of millions of public and private housing units potentially subject to deleading regulations, developers of such technology could make a fortune. Certainly, federal, state, and local health and housing officials eagerly await any new lead-abatement technology.

Massachusetts' 1988 lead law does more than wait. It authorizes a program to investigate, field-test, and approve new ways to remove or cover lead paint. Private firms should feel encouraged to invest in R&D, Prenney argues, because the commonwealth's strict law "creates a much larger demand for deleading than in most places." He is eager to get the program going even though budget funds are scarce, and he is looking to universities to provide expertise that his staff lacks in areas such as polymer science.

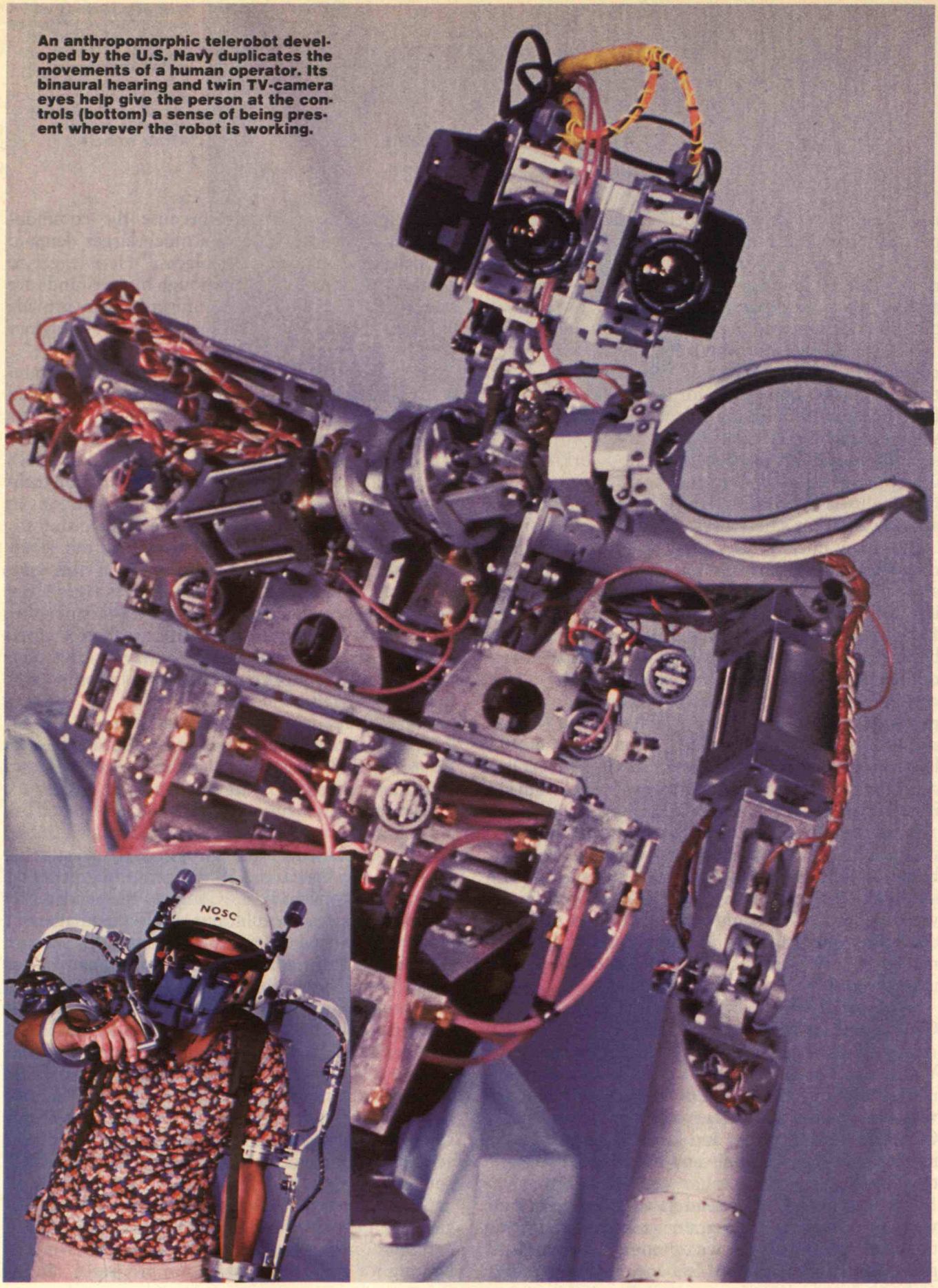
Guyaux agrees that strict regulations spur private-sector action. In the months since Maryland issued its regulations, she says, the drop in abatement costs and the emergence of safer processes have been "phenomenal." Indeed, recent interest in upgrading XRFs and developing new removal and encapsulation techniques was spurred largely by stricter regulations in Massachusetts, Maryland, and a few other states.

Guyaux also cites the rapid growth of the asbestos-abatement industry as an example of how government action can stimulate private-sector progress. Few companies did asbestos abatement before federal law required it. Officials have learned from the asbestos experience, however, that contractors must be properly trained and licensed to do the job safely and effectively.

A great deal depends on federal action. R&D on lead detection and abatement got a shot in the arm from the 1988 amendments to the federal lead law. Frustrated with HUD's unwillingness to impose effective deleading requirements, Congress ordered the department to inspect and begin deleading all public housing by the end of 1995. But now the impetus for R&D may be waning. Within months after laying down the law to HUD, Congress suspended the agency's new lead regulations until safe abatement guidelines could be developed. It also delayed the start of the inspection/deleading period until after completion of a demonstration project designed to evaluate the cost-effectiveness of various abatement methods. This action leaves HUD's inadequate 1986 regulations in effect and signals housing authorities that the requirements may be relaxed.

Federal backtracking highlights the fragile balance between regulation and product development. If private companies sense that regulations won't be enacted, let alone enforced, the recent spate of R&D could dry up quickly.

Cost-effective detection and abatement technologies won't cure lead poisoning. But they will provide ammunition for the growing ranks of advocates fighting for aggressive prevention programs. ■



An anthropomorphic telerobot developed by the U.S. Navy duplicates the movements of a human operator. Its binaural hearing and twin TV-camera eyes help give the person at the controls (bottom) a sense of being present wherever the robot is working.

PHOTO: NAVAL OCEAN SYSTEMS CENTER

BY THOMAS B. SHERIDAN

Merging Mind and Machine

"Telerobots" combine the advantages of human remote control with the autonomy of industrial robots.

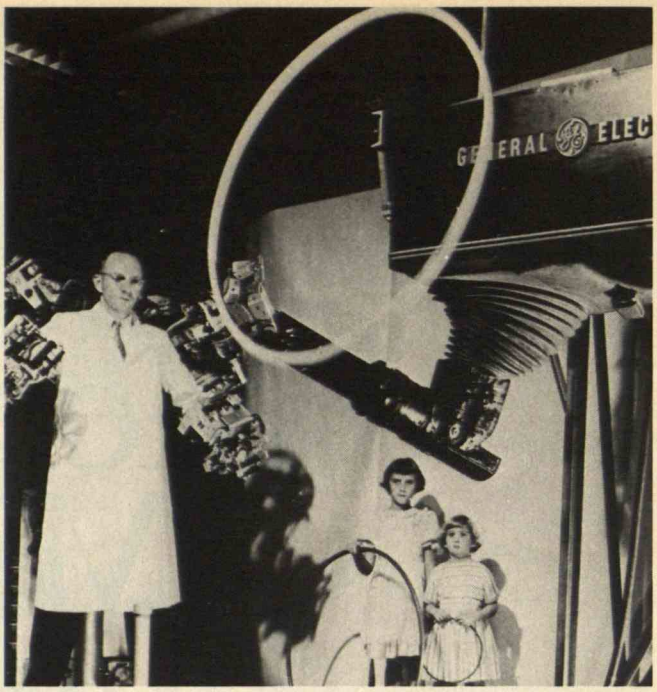
In space, the long arms of the shuttle grapple a communications satellite from the payload bay and push it into its own orbit. In the deep ocean, the *Jason Junior* explorer moves around inside the *Titanic,* sending back eerie photographs from the grand ballroom. In a hospital, a snakelike fiber-optic cable inches through a patient's colon while a physician watches the "inside view" on a TV screen. At times, the cable stops so an instrument can sample a threatening polyp.

Each of these devices is a teleoperator, a device that extends human senses or dexterity to a remote location: deep into space, deep under the ocean, and deep within the human body. Like its relatives—the familiar factory robots that spot-weld or spray-paint auto bodies—the teleoperator has the mechanical equivalent of arms and hands to manipulate objects and do the work.

However, the two machines are very different in practice. The robot acts autonomously: once programmed, it does one assigned task over and over. A teleoperator hardly ever repeats the same task. And it is usually seen not in a factory but in a variety of other settings. Most important, a human operator sees, feels, and controls the remote task through the teleoperator.

The principle behind teleoperation is simple. While it makes sense to physically remove humans from hazards and inconvenience, there is no reason to remove

PHOTO RESEARCH: JAMES P. WALSH



The first teleoperators appeared soon after World War II. In the mid-1960s, General Electric constructed "Handyman" for NASA's Aircraft Nuclear Propulsion Program. The coordination between its master and slave arms was good enough to twirl a Hula-Hoop.

the human ability to recognize patterns and make intelligent decisions. With two-way communication, teleoperation can meld the benefits of mechanization and human intelligence.

Potentially, a teleoperator could do everything a person would normally do to perform a task—as though remote objects were actually seen and handled. And if the operator also had a full sense of being at the remote site, this would seem ideal. That condition is called telepresence.

Full telepresence might sound like the perfect form of remote operation, but it may not always be as good as it sounds. In fact, teleoperators purposely remove human beings from many aspects of the environment: heat or radiation in chemical and nuclear plants, the hard vacuum of space, intense pressure in the deep ocean, the threat of enemy fire. And obviously, forces must be magnified or lessened when a crane operator wants to lift heavy loads or a surgeon wants to micromanipulate a tiny blood clot in the eye. Thus, some limitations on telepresence are in order.

Add some autonomy to the remote teleoperator and the result is the telerobot. Instead of controlling a telerobot's every move, a human supervisor can simply state an objective. The telerobot then makes decisions and acts based on an on-board computer and signals from its own sensors, perhaps doing tasks more quickly and accurately than when the human is in continuous control.

From time to time, human supervisors of telerobots may have good reason to be telepresent. They may want to take over control or experience how the remote task "feels," much as high-level managers sometimes step onto the shop floor. But the human supervisor's prime responsibility is to plan, program, and monitor the multiple aspects of the automation in case there is a failure or until preliminary tasks are finished.

In other words, the ideal telerobot allows the human operator to move freely between supervision of low-level automation and telepresent direct control. For many tasks, this hybrid of human and artificial intelligence and skills can be far superior to either a person alone or one of today's limited-intelligence autonomous robots.

This potential has only begun to be realized, primarily under the sea and in outer space. It will be fulfilled as research in artificial intelligence produces practical capabilities.

THOMAS B. SHERIDAN is professor of engineering and applied psychology in MIT's Department of Mechanical Engineering and director of the Man-Machine Systems Laboratory. He serves as an advisor to NASA, the Nuclear Regulatory Commission, and other government agencies, and he has written widely on human-machine interactions.

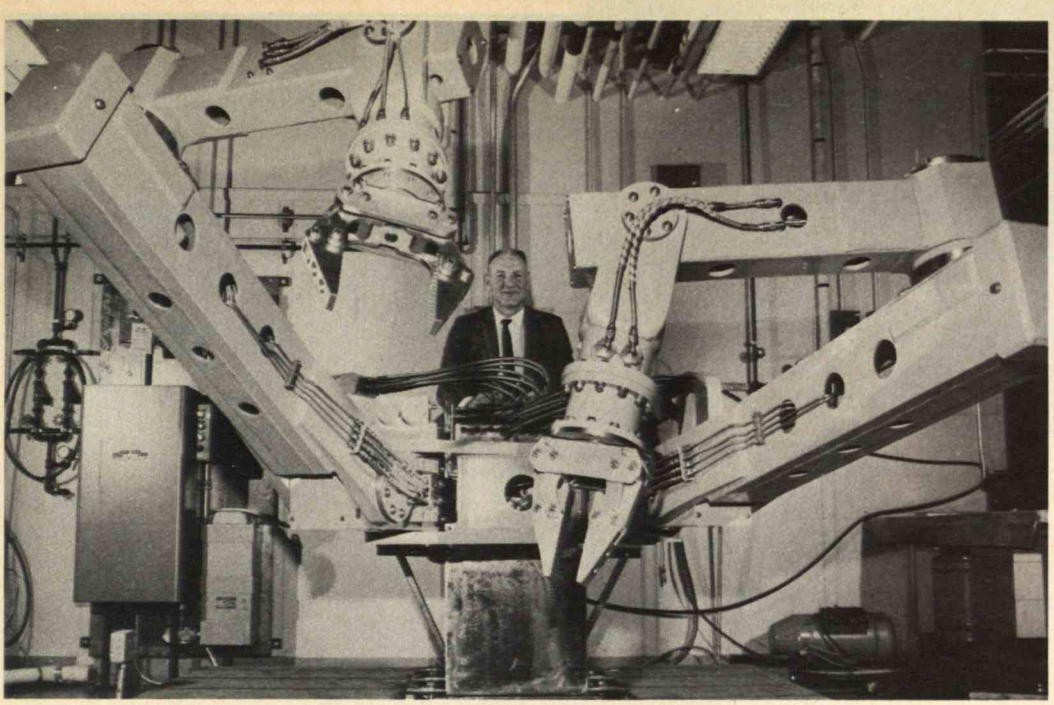
The Birth of the Telerobot

Teleoperators are natural extensions of hand tools like the pliers and screw driver. The first modern-day teleoperators were simple mechanical links in post-World War II nuclear laboratories. These enabled technicians to manipulate master arms and hands, causing slave appendages to perform identical actions with radioactive objects on the other side of leaded-glass walls.

Very soon, researchers added electro-mechanical "servomechanisms," devices like power steering that can magnify or reduce human forces and movements and reproduce them elsewhere. At the same time, electrical or radio links replaced the mechanical connection, and the slave component—the actual teleoperator—was being dropped overboard from ships or rocketed into space.

Even 20 years ago, it was evident that teleoperators could perform many deep-ocean jobs, such as exploring for minerals, with no risk to human divers. An early undersea teleoperator at Scripps Institute in La Jolla, Calif., was a waterproof Army tank carrying a manipulator arm and trailing an electrical cable to carry power and to communicate with a human operator on shore. And a primitive radio-controlled, human-sized teleoperator arm aboard the 1967 *Surveyor* spacecraft scooped up lunar rocks and dust samples for return to earth. A person at mission control watched on a video monitor and gave simple on-off commands to the arm's various joints.

PHOTOS: GENERAL ELECTRIC



An early teleoperator designed to work with the *Aluminaut* submarine was especially rugged. It could operate at a depth of 15,000 feet and in temperatures ranging from 30°F to 120°F.

These early devices had serious drawbacks. Their dexterity and depth perception were poor. They lacked both force feedback (what our muscles tell us about interactions between the hand and the environment) and touch feedback (what our skin receptors tell us about how the forces are distributed on our skin). As a result, the human operator sometimes applied too much pressure, breaking objects, or too little pressure, dropping them. Worse, a several-second delay in communications severely limited earth-to-space control.

Twenty-five years ago, crude telerobots began to emerge in academic laboratories, driven by the limitations of constant human control and the advent of small and cheap digital computers, new sensors, and "intelligent" software. It became evident that computers would eventually resolve many problems by allowing the teleoperator sometimes to act without human instruction, much as our own reflexes quickly pull our hands from a hot stove before we consciously involve our brains.

Graduate students experimenting in the MIT Man-Machine Systems Laboratory found that by invoking this local automatic control for short periods, the teleoperator could handle some assignments more quickly, accurately, and reliably, or with less waste of energy. Similarly, space teleoperators that automatically executed a longer set of instructions began to circumvent the time delay.

This arrangement—in which a human operator gives short-term objectives and a computer directs the machine—is known as supervisory control. A familiar example is the ordinary elevator: a passenger pushes a single button, and the elevator, using its own sensors and electronic switches, comes to the appropriate floor and opens the door. The passenger instructions are symbolic.

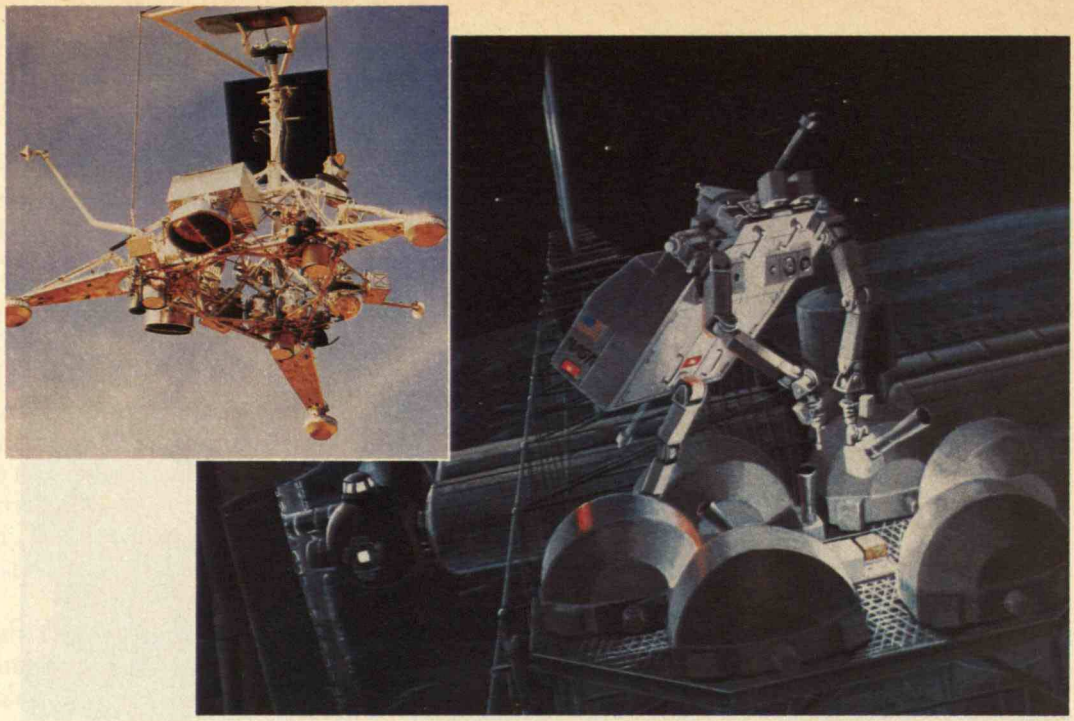
To use another analogy, a supervisor in an organization communicates goals and other instructions to subordinates, who carry out the task with their own eyes, ears, hands, and intelligence. If something unexpected happens, the subordinate reports back to the supervisor for further instructions. Presumably, a skilled and resourceful subordinate can get the job done better, quicker, and certainly cheaper than if the boss did it all.

NASA, a leader in robotics research, now refers to all supervisory-controlled teleoperators as telerobots, without regard to how much control is human. In practice, the form and level of automation depend on the type of work: the better understood and more predictable a task is, the easier and more reliable it is to automate.

The Technology Matures

Today's telerobots don't look much different from those of 40 years ago. Neither does the two-year-old child compared with the one-year-old, but any parent can see the dramatic advances in motor skills and intellect. That is what we are now witnessing in telerobots.

NASA has made the Flight Telerobotic Servicer (FTS) the centerpiece of its bid to apply the technology to space activities. (Other Western nations, including Canada, West Germany, Britain, France, and Japan, have active space telerobot projects as well.) The agency recently contracted with Martin Marietta in Denver to build a human-sized FTS that will have two arms, adjustable video cameras, an on-board computer, and a leg for clamping onto a spacecraft while working. In one scenario, the FTS would slide along a track in the



NASA's Flight Telerobotic Servicer will have two arms, adjustable video cameras, and a leg for clamping onto a spacecraft or space station. Two decades ago, a teleoperator on the *Surveyor* spacecraft (inset) scooped up lunar rocks and dust samples for return to earth. A person at mission control watched on a video monitor and gave simple on-off commands to the arm's various joints.

shuttle cargo bay. In another, it would hang on long manipulator arms. In still another, it would maneuver in space with its own jet backpack.

However, the exact jobs for the FTS have not been decided, in part because of a wide disparity of opinion within NASA about what telerobots should do and when they will be ready. One faction, encouraged by the spectacular success of automated planetary probes, sees telerobotics as a cheaper and ultimately more reliable way to conduct space activities than supporting humans in that hostile environment. For example, telerobots might service scientific experiments on the shuttle or on a space station, and even assemble the station itself.

Another faction—including most astronauts, those committed to support them, and robotics skeptics—thinks that telerobots won't be advanced enough for the launch of the first elements of the space station in the mid-1990s. This group sees telerobots as simply one of many useful backups for the first-stringers, the astronauts, who will always be needed when things don't go precisely as planned.

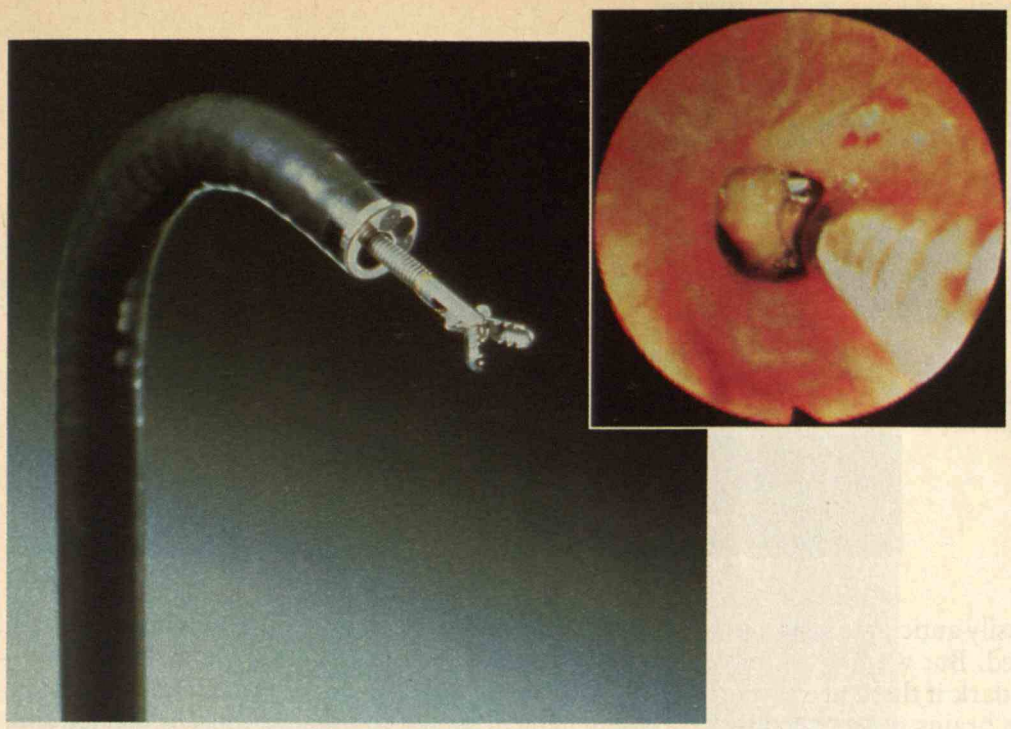
In this debate, NASA partly reflects the common lay perception of a "human versus robot" dichotomy. Automation is seen as all or none. But in reality, teleoperation is a spectrum, not a polar choice. At one end is direct and continuous master-slave communication; at the other, a (fictional) fully autonomous robot. In between are many degrees of automation. No robot operates without initial programming by a person and some monitoring and adjustment from time to time.

NASA notwithstanding, many applications of telerobots arouse little controversy. The oil companies and the navies of the world have long provided the funds and incentive for undersea teleoperators. Far more teleoperators have been at work in the oil industry—inspecting and maintaining offshore structures, wellheads, and pipelines—than in any other field. Marine biologists and the fishing industry are also investigating teleoperators for observing and sampling marine life, not only on the ocean floor but at all the intermediate depths, which form 95 percent of the earth's biosphere. Through a fiber-optic cable attached to the *Jason,* scientists from Woods Hole Oceanographic Institution can inspect hydrothermal vents three miles below the surface of the world's oceans. The telerobot submarine recently let researchers manipulate clay jars on a 2,000-year-old sunken ship.

In the nuclear power industry, researchers are experimenting with ways to extend the abilities of telerobots for servicing and repairing reactors. Mobile telerobots under development at the Commission Energie Atomique in Paris can automatically climb stairs and avoid obstacles. Japanese scientists are investigating specialized telerobots that crawl inside pipes and perform intricate x-ray inspections, looking for cracks. And prototype telerobots at Westinghouse worm their way through narrow openings and into highly radioactive areas to replace leaking tubes in steam generators. These have been a continuing trouble spot in nuclear power plants.

An application that designers find particularly challenging is telerobots for assisting the physically handicapped. Already, signals from electrodes on a person's muscles can actuate prosthetic arms and hands. A newer approach, under development at Stanford University, is a stand-alone mobile robot that will respond to speech or other symbolic messages to fetch objects or perform self-feeding and bathing. For example, by moving his or her head, a quadriplegic might

PHOTOS: NASA, MARTIN MARIETTA



In medicine, teleoperators are only beginning to realize their potential. With forceps at the end of a quarter-inch-wide bronchoscope, doctors can take a biopsy of a tumor without making an incision.

direct a laser pointer to different instructions for the telerobot. However, getting reliable control signals from a handicapped person to the telerobot has proved to be exceedingly difficult, and there are still no reliable telerobots for replacing one's own limbs. In addition, such machines may look ugly, even threatening, so many disabled people resist using them.

The Human Model

While teleoperators and telerobots assume many different forms, they all have trouble communicating with their human operators. Researchers at the Man-Machine Systems Laboratory, MIT's Research Lab of Electronics, Oak Ridge National Laboratory, and Caltech's Jet Propulsion Lab are working to improve the collaboration between humans and intelligent telerobots. Analogies with the human body and interpersonal relations are key to these endeavors.

Consider a few of the body's most primitive capabilities—the sense of touch and our awareness of forces, distances, and limb position and velocity. How easily and naturally one-year-olds integrate these to grasp and bring objects to their mouths—even without looking. A teleoperator can have separate transducers that sense surface contact, gross forces, position, velocity, and distance. But the state of the art for some of these devices is primitive. Moreover, telerobots are far from being able to integrate all this information as even a one-year-old does.

Today's mechanical touch sensors have extremely coarse resolution, though fiber optics and microelectronics promise some improvement. And no one has found a satisfactory way to convey "teletouch" information from the sensors in a slave finger to the human's fingers and hands. As yet, the most straightforward method generates a pattern on a computer-graphic screen, letting human operators "touch" with their eyes.

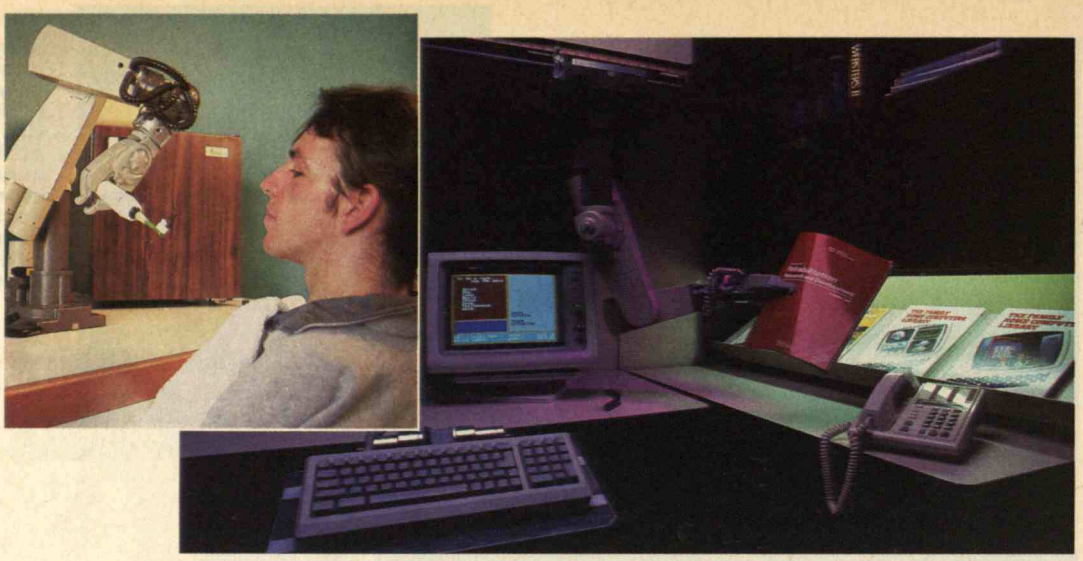
Such efforts are complicated by the fact that our bodies tense muscles for some tasks and relax them for others. This comes naturally to humans, but only recently have teleoperators gained the ability to be gentle upon first touching an object and then to exercise precise and forceful control. Variable stiffness is complex because not only must the slave arm be made rigid or soft, but the master must also be able to change so the human controller has feedback on what is happening. But should the forces match at the two ends? MIT doctoral student Jagganath Raju has only recently concluded the first experiments on this "bilateral" stiffness problem. These show that for some tasks, it is better if one end is stiff and the other soft.

For detecting gross forces, strain gauges on the teleoperator's wrist can feed sensory data back to a set of motors on the master handle. But added bulk and resistance can compromise the operator's dexterity. Also, the teleoperator's camera, with its limited field of view, can't always show where the remote limbs are moving.

Similarly, when setting a dinner table, we humans need attend only to our hands—our elbows automatically avoid knocking over the crystal. To replicate this ability, MIT engineer Hari Das recently developed a "parallel-control" technique in which the human operator guides the teleoperator hand while a computer configures the joints to stay clear of obstacles. This is clearly supervisory control, since the computer must mediate the operator's commands and coordinate their execution.

In another analogy to human beings, for everyday

PHOTOS: OLYMPUS CORPORATION



Stanford University researchers are developing a teleoperator servant for disabled people that can respond to speech. They are adapting the device to function in offices and homes.

repetitive tasks our brains easily anticipate how much force and motion are needed. But we may stumble when climbing stairs in the dark if there is one more stair than we thought. Our brains accept feedback and correct our "mental models" in response to the unexpected, but when the teleoperator is in space, the several-second delay makes prediction and control difficult.

Research on the time-delay problem began at MIT in the mid-1960s and has evolved recently into techniques that overlay a computer-based prediction on the TV picture. In effect, this tells the operator what the telemanipulator will do several seconds in the future. The technique has recently been extended to predict contact forces as well as position.

Humans are adept at perceiving depth. We not only have two eyes for this, but we constantly improve the sense by moving our heads to get different angles. Stereo viewers, with separate remote cameras and corresponding screens for each eye, have been built but are not fully satisfactory because our eyes have difficulty fusing the two views into a single image. A better technique mounts one or two miniature video monitors in goggles on the human operator's head. By measuring head position and angle, these systems allow the wearer to control the motions of the teleoperator cameras through head motions. The human operator sees on the screen just what the "remote head" sees, providing a striking feeling of telepresence. The cameras are restricted in their movements, but, based on known data about objects in its environment, a computer can simulate a view from anywhere the operator chooses.

Teaching Telerobots

Given a telerobot that might match or improve human motor and sensory skills, the problem remains of teaching it new skills. When humans teach a skill such as tennis, we use our hands to point, gesture, and demonstrate, at the same time stringing words into sentences. The same symbolic lessons must be conveyed to a telerobot, whose computer initially may know nothing of a task or its context. Objects must be pointed to and named. Spatial coordinates must be defined and scaled.

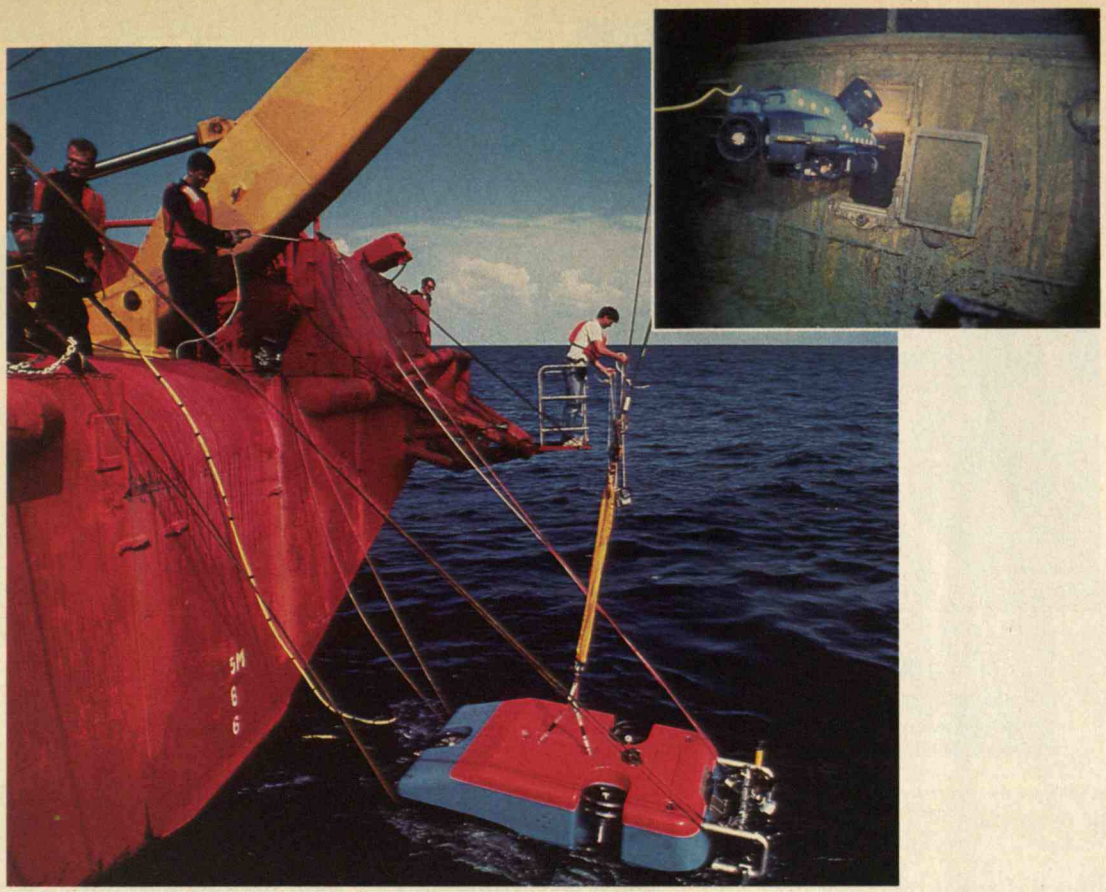
To "teach" machines, Richard Paul of the University of Pennsylvania and various robot manufacturers have developed numerous sophisticated programming languages. However, there is still a long way to go until a telerobot can be taught any but a simple task with English-like commands. One thing researchers have learned: it is easier to instruct the telerobot by specifying locations relative to real objects that it can see and touch rather than relating them to positions on an absolute grid. The telerobot, like a human pupil, has difficulty relating to the abstract.

Consider, finally, that people often know what we mean even if we don't say everything. In the future, general-purpose telerobots might imitate a person's ability to glean meaning from observed context and common experience. Research by MIT engineer Wael Yared has recently shown that when a human supervisor gives a telerobot a plan of action, the machine can distinguish the supervisor's intent from the recommended steps to fulfill it. Then, if the telerobot encounters obstacles, it knows what substitute actions are acceptable. Moreover, these telerobots can use their acquired experiences to simplify communication for future tasks. They could even advise an operator who asks for something that is not possible. In this area, computer linguistic analysis and artificial intelligence are two keys.

Telecops and Telesurgeons

Several applications illustrate the challenges faced by designers of telerobots and teleoperators. For example, a great deal more research is needed for jobs that require moving about buildings. Today's human-programmable telerobots can retrieve parts from bins,

PHOTOS: STEFAN MICHALOWSKI, CENTER FOR DESIGN RESEARCH, STANFORD



Some of the earliest—and latest—teleoperators work under the sea. The *Jason* telerobot submarine recently let researchers manipulate clay jars on a 2,000-year-old sunken ship. In 1986, the Jason Junior (inset) explored the inside of the *Titanic*, sending back eerie photographs from the grand ballroom.

deliver mail, wash windows, and do other relatively straightforward tasks. But the environment in which they work must be relatively well-behaved and rigged with mechanical, electronic, or optical devices to assist in navigation. Thus, these rather specialized machines are essentially regular robots—once programmed, they require little supervision. Future telerobots will do jobs ranging from cleaning streets and the floors of buildings to inspecting and painting bridges.

Similarly, mobile telerobots perform routine police sentry tasks on flat terrain. They detect movement and send pictures back to a central monitoring station, but they need well-defined and clearly marked roadways. Eventually, sentry telerobots must be able to move autonomously outdoors or in crowded buildings, climbing stairs and making subtle discriminations about what is normal and what is not. This entails elaborate computer models of what sights and sounds are normal and of the relationships between perceived objects.

An especially exciting challenge is to develop a fire-fighting teleoperator that can enter a burning building, send back pictures, assist in putting out the fire, and even rescue victims. However, many of the same mobility problems are involved, not to mention the need to tolerate high temperatures.

Several sophisticated applications involve working on or in the ground. Ordinary earth-moving, mining, and construction machinery, as well as plows and harvesters, are actually primitive mechanical teleoperators. The goal is to use new sensors and computers to allow remote operation so that the human supervisor could monitor them from a safe location and even attend partly to other tasks. One problem is developing telerobots than can exert large forces over large distances without toppling over in order to move earth and coal or to manipulate building and bridge components. And jobs like shearing sheep or picking fruit require finer visual and tactile discrimination.

Airlines and other aircraft operators are examining the possibility of repairing planes with teleoperators. For example, it can be difficult to see deep inside an engine or to get a hand in to make repairs. The goal is a telerobot with enough degrees of freedom to reach in and around almost anything.

Even more dexterity is needed for "telesurgery," in which micro-teleoperators would examine and operate inside the body. Fiber-optics research is yielding ever smaller, higher-resolution endoscopes with which surgeons examine the stomach, colon, or other body cavities. And the spectacular success of arthroscopy for surgery inside knees—through small openings in the skin—suggests that similar procedures will eventually serve other body sites, reducing the need for cutting. However, medical telerobots probably won't need onboard computers for quite a while, in part because the hardware can conveniently stay outside the body. Potentially, the computer in this case can recognize patterns and store information from visual, thermal, tactile, and chemical sensors carried at the "end effector" of the telerobot, complementing the trained eye of a surgeon.

PHOTOS: WOODS HOLE OCEANOGRAPHIC INSTITUTION

Ion Track Instrument's Roh-Veh teleoperator can dispose of bombs safely. It fires a high-velocity slug of water into a suspect package to disrupt a bomb's firing mechanism. With little modification, the same teleoperator can put out fires (inset) in situations too dangerous for human firefighters.

A Troubling Scenario

Despite the formidable challenges, teleoperators and telerobots *are* removing people from hazardous environments. Researchers are gaining new insights into human skill and interactions as they seek to extend human sensory and motor capabilities and enable people to communicate with telerobots. Yet military interest in telerobots and teleoperators raises some ominous possibilities. Already, the military has a number of uses for telerobots. One proven application is bomb disposal: a teleoperator can disassemble a bomb, or gently lift and carry it away intact. Navies have their own ideas. Many of them are secret, but they probably include installing and maintaining undersea fiber-optic communication networks for submarine surveillance. Understandably, the military is investing heavily in telerobotics R&D.

Now consider a military teleoperator with good land, sea, or air mobility, a good communication link to a supervisor, and sensors and dexterity better than those of a person. A human operator could send this teleoperator to do mischief in anyone's backyard. A pipe dream? Already, satellites that are remotely guided and operated spy over territories where they are unwelcome. And teleoperated submersibles from industrialized nations, including the United States and France, are digging up minerals from the ocean bottom in areas claimed by poorer nations. This was a major concern of the Law of the Sea Treaty—and one reason that the United States refused to sign it.

Now imagine a future telerobot with a computer to help it see, hear, touch, and move, able to conserve energy and adapt to its environment, and intelligent enough to pursue its programmed goals despite disturbances or obstacles. This telerobot may do even more mischief, since it can function for long periods without communicating with its supervisor. Such telerobots are already being developed by the militaries of the industrialized nations to spy, sabotage, set explosives, and perform a host of other duties. All the U.S. armed services are engaged in this research, much of which is classified.

Some observers have heralded the dawn of smart weapons, battlefield robots, and "telegladiators" as a new day when international disputes will be settled on a technological playing field, away from real people. Here technical prowess will win the day and no one will die. Some military planners seem to be moving toward that fantasy even now.

In past arguments, fights, and wars, violence has put human beings at some bodily risk. That simple fact has been stabilizing, to some extent restraining those who would engage in conflict. Technology has been gradually removing that restraint, as weapons have evolved from clubs to arrows to bullets to bombs dropped from airplanes. Telerobot technology—on land, undersea, and in space—is the obvious next step.

This is not a novel theme; it has been put forward before by science-fiction writers. Unhappily, it is ever closer to becoming a reality. The same technology that insulates workers from hazardous environments makes it easier for human operators to hide from the effects of their own actions. Thus, the technologists who are extending the abilities of these marvelous machines must take whatever steps they can to ensure that their inventions will be instruments of progress, not of destruction. ■

PHOTOS: ION TRACK INSTRUMENT

MIT

OCTOBER 1989

MIT

OCTOBER 1989

COVER:
A brisk, sunny day and Boston's skyline in the background, along with some warm foul-weather gear, provide the perfect setting for a late-season competitive sail on the Charles.

PHOTO: BRADFORD F. HERZOG

Minority & Ethics Education—Special Cases or No Case at All?

TEACHING ETHICS

Jonathan Richmond's column "Ethical Tools More Useful than Rules" (*May/June 1989, page MIT 3*) should be expanded to discuss values and value systems that affect the quality of life on earth. Included would be non-polluted air and groundwater, the culture of our neighborhoods and workplaces (i.e. open, safe, friendly, fair, supportive), and the political institutions under which we live (democratic freedom, promotion of individualism, rule of law, and so forth).

The study of ethics and values must include a study of history, the rise and fall of nations, the struggles for freedom and its status in various parts of the world. Western culture, with its representative government, is worth preserving for our own sake and for the sake of mankind as a whole. Nations that lose their unity and their capacity to defend themselves will ultimately be displaced.

Someone has to stand up for those conditions that make life worthwhile—and do so at times that allow quiet reflection as well as at times that require stronger, perhaps disagreeable, action, which is the essence of leadership. Many an "ethical" argument is used to cover the lack of a value system or to escape from taking responsibility.

Air pollution and overpopulation are perhaps the two greatest perils facing humanity. Engineers and scientists share as much responsibility for these problems as anyone else, and their ethical and value systems have to confront that reality.

ABBOT FLETCHER, '47
Bath, Me.

Jonathan Richmond's column illustrates why the study of ethics is best left out of the engineering curriculum. His central premise is that those who pursue ends with which he disagrees, such as weapons development, are guilty of a lack of insight or understanding and must therefore require education in ethical thought. He insults me by implying that my commitment to national defense is thoughtless or unexamined, or that my co-workers are necessarily less philosophic than those in other industries.

Richmond's list of examples of ethically questionable projects displays a worrisome imbalance that leads one to suspect a lack of objectivity as well. I fear that the kind of ethics course advocated by Richmond would degenerate into a forum for specific political causes. Rather than learning to examine ethical issues, students would learn to express concern for Richmond's agenda. And even worse, students would be propagandized, in the name of education, without an adequate forum for opposing views.

I am skeptical of the Institute's ability to sponsor an ethics course with a neutral political and moral content, especially in light of the charter of Jonathan Richmond to teach moral philosophy in a civil engineering class. Some might argue that, in principle, it is impossible to teach ethics without advocating that which is ethical. But disagreements over "that which is ethical" are what make objectivity so elusive and ultimately negate the desirability of trying to teach ethics.

I don't object to urging engineers to be ethical or to consider their actions in larger contexts. However, until the Institute can show that an ethics course will not degenerate into a platform for the trumpeting of specific political beliefs, I will continue to oppose such an addition to the curriculum.

BERNARD BEARD, '79
Palm City, Fla.

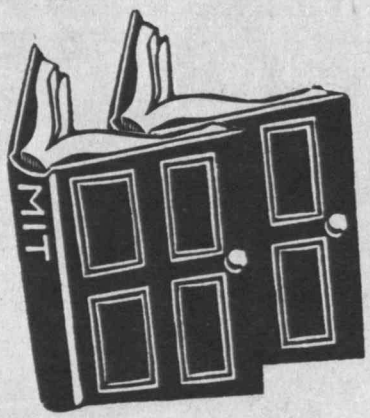
Jonathan Richmond responds:

Mr. Beard's allegations that I am out to brainwash students with particular beliefs cannot follow from my column, which states that "the hardest lesson of all is that

there is no one way 'to be good,' " and that the role of education should *not* be to teach specific rules of ethics, "but to instill a mode of thinking that compels us to consider the ethical nature of everything we do." A course in engineering ethics should provide a training in exposing and critiquing the ethical assumptions of any given approach. The aim is to teach thinking, not preach politics.

His call for a "neutral . . . moral content" is a contradiction in terms, since ethics is the study of what we *should* do. Alternative and conflicting ethical principles and courses of action should certainly be discussed, but each principle must necessarily stake out a moral position.

Most disturbing is Mr. Beard's conclusion that because of disagreements over "that which is ethical," ethics should not be taught at all. It is precisely because there *are* disagreements that students should be aware of the choices to be made and equipped to make those choices for themselves, rather than to blindly accept the ethical assumptions of any engineering technique.



ADMISSIONS AND THE PRESIDENCY

There is one point in my most recent letter to the editor (*July 1989, page MIT 2*) that did not get into print, and it is an important one. I am concerned that the admissions policies supported by Paul E. Gray, '54, have weakened the Institute, and I think this consideration should carry considerable weight in the search for MIT's next president.

Upon entering office, President Gray had his agenda for change, and that agenda included making the MIT community a more diverse mix of individuals. As a result, there has been an increase in African American and Hispanic enrollment from slightly more than 5 percent in 1979 to 15 percent at present, and an increase in the enrollment of women from about 15 percent to 35 percent. Similar objectives for the faculty have met with less success.

This kind of social engineering is best left to the domain of the social scientists, and social science has not been MIT's traditional strength. If MIT, not as a university but as an Institute of Technology, is to achieve and maintain excellence, it must have one criterion for student selection, and that is academic excellence—irrespective of other arguments.

MIT is a national resource, and it best serves this nation's interests now and for the future by not diluting or abandoning the overriding concept of academic excellence as the single most important criterion for student selection. To achieve the highest expression of academic excellence, student selection must be blind to race, color, and gender.

JAMES O. JUSTICE, '47
Palm Desert, Calif.

RACE SHOULD NOT BE A PROGRAM REQUIREMENT

I was disturbed by the article "Interphase Touches Its Roots" (*July 1989, page MIT 13*). Interphase was described as "an eight-week program . . . to provide both academic and social preparation for MIT." What I found disturbing was the chilling explanation that it was "open to minority students by invitation only." This is a blatantly racist policy that does not belong at MIT.

If the program's goal is to remedy deficiencies in the backgrounds of students who grew up in poverty or are from broken homes, who are the first in their families to attend college, who are not fluent in English, or whose standardized test scores are low, let it be open to all such students.

I would hope that all students who need help are offered an opportunity to enroll in Interphase and in other MIT programs, and that no programs are limited to students with approved racial characteristics. I suggest that academic credit not be offered for Interphase; it neither seems appropriate at MIT nor fair to the mainstream students.

MYRON KAYTON, PhD '60
Santa Monica, Calif.

PHOTOS: L. BARRY HETHERINGTON

The Class of 1984

At the POPS!

Every year the faces change and the activities vary, but at least four constants proclaim that this is Reunion Weekend at MIT: the spirit of friendship, the longevity of intellectual curiosity, the generosity of alumni/ae, and Tech Night at the Pops. Before we convey a sampling of the first three, here is the opening act of the weekend, as reviewed by the Secretary of the 50th reunion class.—Ed.

Tech Night at the Pops is always a treat. Opening with Sousa's "Washington Post March," Conductor Harry Ellis Dickson made sure the audience was thoroughly awake to absorb and enjoy the first third of the program.

For the middle third of the concert, guest artist David Witten, now an affiliate artist at MIT, performed Piano Concerto No. 1 in B-flat Minor, Opus 23, by Tchaikovsky. Three movements in the concerto enabled pianist Witten to perform in the whole range of tempos, tones, volumes, and moods, giving the grand Steinway a most comprehensive workout.

For the final third of the program we hundreds stood to be mutually stirred by singing "Arise All Ye of MIT" by John Wilbur, '26. Conductor Dickson closed with music in a lighter vein, including "Sing, Sing, Sing" from the Swing Era, and four encores.

Altogether a thoroughly enjoyable evening—with all the charm and thrills we have come to expect and enjoy at the Pops these last 50 years.—*Hal Seykota, '39.* □

Emily V. Wade, '45, (top) handing over the gavel of office on T-Day to incoming Alumni/ae Association President Harris Weinstein, '56, who responded, "We should bronze [Emily's] shoes and hang them in Building 10. I can't fill them, and I don't think anyone can." (Bottom) Malcolm H. Finley and Domingo J. Bellingeri, both Class of '24, enjoying memories triggered by an old yearbook.

Resurrecting the Space Program:
Back to the Small Steps

By John Mattill

Twenty years after its greatest achievement, the U.S. space program is rising from the ashes of its greatest disaster.

And MIT, home of the inertial guidance technology that was essential to the lunar landing 20 years ago, will have major roles in the future, alumni were told by a panel of faculty at the Technology Day symposium on June 9. Indeed, commented one alumna as the program ended, it's "clear that this place is breeding a new kind of beaver—a space-bound beaver."

But it will not be easy.

There are a host of unanswered questions and some tough technological problems to be solved. And the nation must never again fall into the take-it-for-granted optimism that prevailed before the *Challenger* accident, described by Astronaut Frederick H. Hauck, SM '66, as "a fairy tale gone wrong." Space flight will never be "risk-free," Hauck warned. He was commander of *Discovery*'s first post-*Challenger* flight, and remembers that the 8.5-minute boost phase seemed to last almost forever. "I hoped it would all hold together," he told the standing-room-only audience in Kresge Auditorium.

Dean Jack Kerrebrock

Acting Dean of Engineering Jack Kerrebrock, who was a member of the *Challenger* investigating team, reiterated Hauck's emphasis on risk. "Getting into orbit is still the hardest part of space flight," he said. "Every launch system is subject to variable conditions from flight to flight: there is always the possibility of a failure due to an unknown problem."

Kerrebrock thinks U.S. policymakers may still not be taking this problem of launch risk seriously enough. There is too much reliance on major new initiatives and programs "somewhat at the expense of adequate investment in the development of more reliable launch systems," he said.

Among options for the future, Kerrebrock's choice is the "aerospace plane," a system that would be powered by a supersonic combustion ramjet ("scramjet") so powerful that a single stage could put a spacecraft into orbit from the earth's surface. This system would require not only a successful scramjet—a "very difficult engineering endeavor"—but also new high-temperature, low-density materials and structures, advances in aerodynamics, and significant advances in control. But the system has a great deal of promise, he said, and the best strategy for pursuing it is to concentrate on the scramjet as the critical new technology.

Professor Edward F. Crawley, '76, emphasized a different set of space-age problems—the need for "extreme accuracy" in the structures that will have to be assembled in orbit. For example, he said, a space-based optical interferometer would give extremely precise images of nearly invisible stars and reveal planets, if any exist, in near-earth star systems. But the separation of its two optical sensors at the ends of a 100-meter beam in space would have to be maintained with incredible precision—plus or minus 10 nanometers (billionths of a meter). It's not clear that a structure so precise can be built in space, said Crawley, though he described MIT experiments that prove astronauts

can build large assemblies in orbit.

No one nation will have the resources to achieve the number, size, and precision of structures that Crawley anticipates. International collaboration will be essential, he said, and "only with a willingness to share" will America be among the nations that lead in space in the next decade. For models of collaboration, Crawley cited plans for the space station that will be launched in the 1990s, the International Space University conceived and given life by Peter H. Diamandis, '83, and student exchanges between MIT and the Soviet Aviation Institute, which the Soviets opened to foreign visitors only last year.

Though he's both an expert in and advocate of manned space flight,

Professor Laurence Young, '57

Professor Laurence R. Young, '57, director of the MIT Man-Vehicle Laboratory, is the first to admit that space is a risky environment. The absence of gravity presents several serious health hazards—bone demineralization, muscle atrophy, cardiovascular changes, reduced protection by the immune system, motion sickness, even psychological disturbances.

"I seriously doubt the viability of a manned mission to Mars without substantial additional information" about these problems and possible remedies, he said. Nor is there enough information about low-gravity environments to justify a lunar

Boogying in the boathouse—1984 celebrates its 5th (top). Sina Najarian, whose husband Thomas, '69, stands directly behind her (center), regales members of the 20-year reunion class with a preprandial recital at the elegant new Boston Harbor Hotel—prandial, in this case, referring to "Hors d'oeuvres Heaven" (bottom).

First things first—getting name tagged and registered at Kresge (top). (Center) 40th Reunion Gift Chairman Tom Toohey, third from left, with friends from the Class of '49 at a preconcert dinner in Symphony Hall. (Bottom) The Classes of '79 and '84 enjoyed roller skating in the iceless rink at the Athletic Center.

base, Young said.

Improved materials and processing technologies have been an early benefit from the space program—a "simply revolutionary" impact, said Professor August Witt. He described "significantly superior" semiconductors manufactured in zero-gravity en-

Professor August Witt

vironments, even "an entirely new class of metallurgical systems."

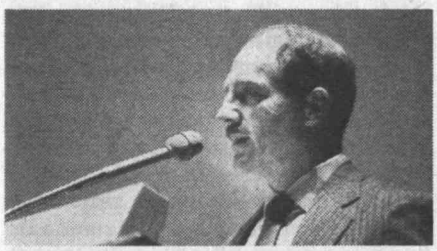
But in the future, warned Witt, "we need to do our homework better than we have in the past"—have closer ties between experimenters and the astronauts who perform the experiments in space and more emphasis on the theory behind the glitzy results.

Observations from space have also sparked a revolution in cosmology and the earth and planetary sciences, said Professors Claude R. Canizares (physics) and Ronald G. Prinn, ScD '71 (earth sciences). "We are standing on the brink of a rebirth of space science and technology after a 10-year hiatus," Canizares declared. His enthusiasm is based on the prospect of the Hubble Space Telescope (to be launched in 1990) and other new space-based observatories thereafter.

Already MIT has made major contributions to planetary science through radar mapping of Venus and development of the space plasma instrument on *Voyager 2*. The latter sailed by Neptune last summer and is now leaving our solar system.

The important tools will come in the 1990s—an earth-observation system that will take simultaneous measurements of all kinds of terrestrial and atmospheric phenomena from the satellite-borne instruments of many different nations. The goal, Prinn said, is an intimidating one: "to predict what may happen to our planet in the next 100 years." Greenhouse warming is but one of the problems of which understanding is now incomplete, he said.

At the traditional T-Day luncheon, President Paul E. Gray, '54, called attention to the presence of three alumni astronauts—Byron K. Lichtenberg, ScD '79, Hauck, and Jerome Apt, PhD '76. In all, he said, 17 alumni are or have been members of the astronaut



Astronaut Frederick Hauck, SM '66

corps—more from any institution except the U.S. Naval Academy. Among them: Edwin (Buzz) Aldrin, ScD '63, the second human ever to stand on the lunar surface.

"Technological development is the cornerstone of our economic well-being," said Gray. "I have no doubt that, among all technologies, the often-underestimated and undervalued space program will eventually play a key role. Space manufacturing, the use of extraterrestrial resources, and the colonization of space and celestial bodies will eventually comprise the broadest of frontiers.

"The questions are only *when* these things will happen and which nations will lead in carrying them out," declared Gray.—*John Mattill* □

How MIT Stays in Orbit

Reunioning alumni and alumnae this year reaffirmed their commitment to ensuring that MIT continues at the cutting edge of scientific exploration and technological training. One of the most immediately beneficial ways of demonstrating that commitment, of course, is financial support, and reunion class gifts announced at the Technology Day Luncheon in June reached a grand total of $15,858,000 from the eight major quinquennial classes.

More than 1,500 alumni, spouses, and guests attended the day-long program on the status and future of space exploration. The luncheon in the Howard Johnson Athletic Center attracted 1,200 people, one third more than usual—and 100 more than expected.

After the meal, the gift chairmen of the three major reunion classes presented their class gifts to President Paul E. Gray, '54. Reunion Gift Chairman James W. Barton of the 50th reunion Class of '39 announced a gift of $5,611,000 and a bequest commitment of $1,159,000. J. Thomas Toohy, gift chairman for the 40th reunion Class of '49, reported a gift of $5,300,000. And on behalf of the 25th reunion Class of '64, Robert P. Popadic announced a gift of $1,964,000. The gifts from these classes are composed of all gifts made to MIT by members of the classes during the five years preceding the reunion and all pledges to be paid in the five years following the reunion.

Other classes reporting were the Class of '24 with $2,054,000; the Class of '29 with $773,000; the Class of '74 with $70,000, the Class of '79 with $63,000, and the Class of '84 with $23,000. In addition, this year's graduating class contributed $5,475 toward the establishment of a Class of '89 Scholarship Fund, with an additional $15,600 pledged over the next four years.

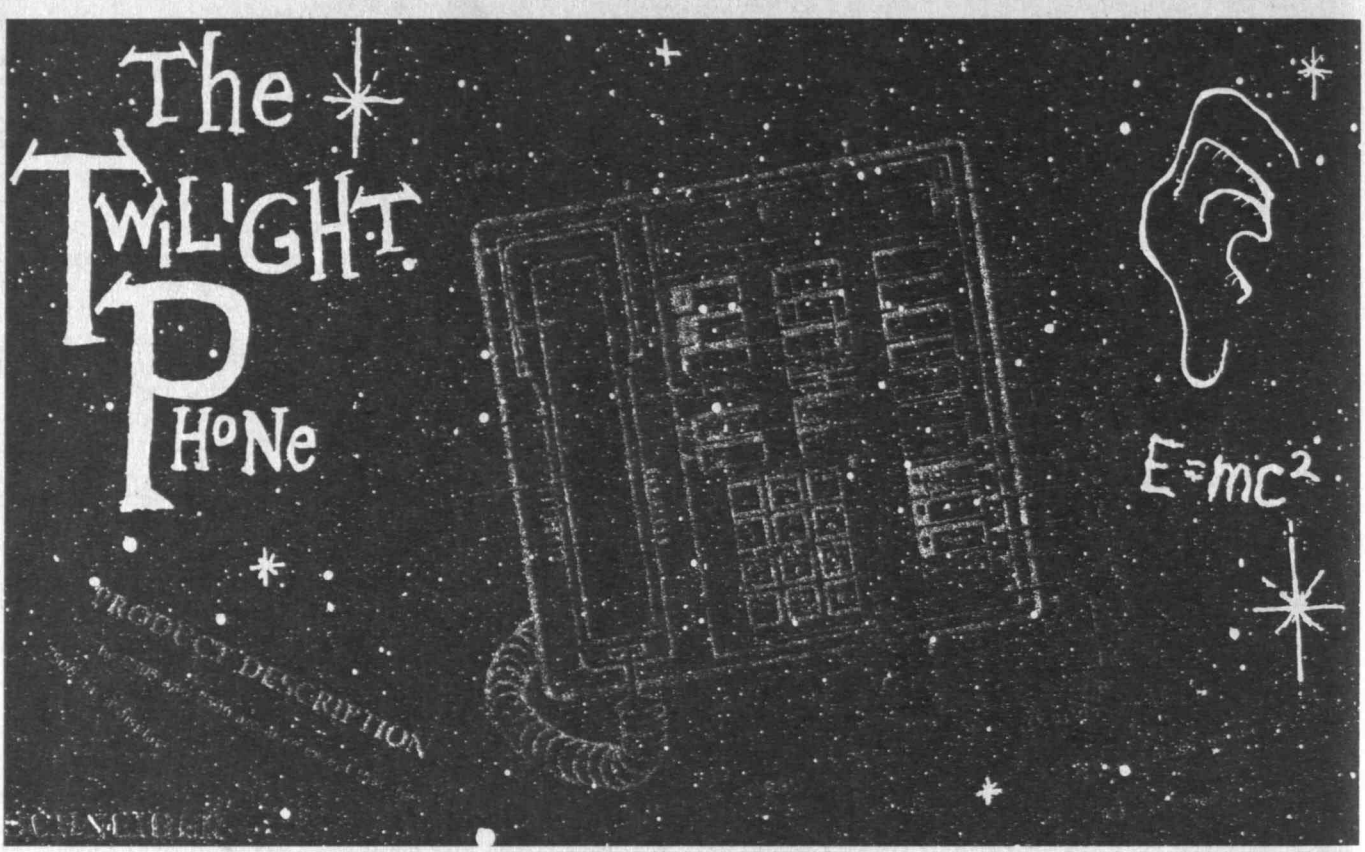
Expressing his gratitude for the gifts to the Institute, Gray told the gathering that "MIT is blessed by its alumni—your quality, your leadership, and your generosity."

Gray's luncheon remarks continued the morning's focus on the space program. In addressing the "often underestimated and undervalued space program," he said that the necessary public understanding and support for future ventures "brings us back to the problem of the public's wariness about science and technological developments." Working with our communities and schools to "rekindle the spark that led to the renaissance in science education three decades ago" (the post-Sputnik era) is a first step, he continued. "We need to remind ourselves and others that science and technology are not the separate province of an elite few, but that the iridescent spirit of discovery that underlies science is there *in* us all and it is there *for* us all."

Sixty-four classes were represented at the luncheon, including, for the first time, a 70th reunion gathering of several members of the Class of '19. The oldest alumni attending were Eli Berman and Max Seltzer, both of the Class of '18. Of the 24 international alumni representing 16 countries, the three who traveled the farthest were Capt. Adul Pinsuvana, '59, from Jakarta, Indonesia, and from China, Professor Wing Lem Wu, '34, of Beijing, and Charles Y. Wang, '39, of Shanghai.

Emily V. Wade, '45, 94th president of the Association of MIT Alumni and Alumnae, presided at the luncheon program. Before turning the symbolic gavel of office over to incoming president Harris Weinstein, '56, Wade announced that the Association was bestowing honorary membership on an astonished Norma Mele, who recently retired as house manager at McCormick Hall for many years. Mele was recognized for having "taken a special, personal interest in each of the more than 1,000 young women—her 'girls'—who have lived in McCormick Hall since the dormitory was built." □

BY SCOTT CAMPBELL



The long-awaited, highly touted, state-of-the-art, future-oriented MIT telephone system has arrived. It took more than three years to install. It cost more than $20 million. But when the new telephone system was finally put into service last year—on Saint Jude's Day, the day for Hopeless Causes—the people of MIT were not pleased.

The cords were too short. The phones were too light. Transferred calls got lost in limbo—and may still be floating there, even now. And then there were all those rumors! People said, for example, that it was possible that the entire system could be reprogrammed through any one of the phones. Worse than that was the fact that any room could be bugged!

The nifty digital telephones in the Telecommunications Office lit up like Christmas trees. There were several hundred callers a day, alarmed at this, questioning that, and confused about the third thing, until it seemed all of MIT was convinced the apocalypse was at hand.

It has now been many months since all the excitement and confusion began, and a certain uneasy calm has settled over the Cambridge campus. At this writing, the number of trouble calls has leveled off to 22 per day—eight calls fewer than the Telecommunications Office had grown accustomed to with the previous system. And the glaze of utter panic has vanished, for the most part, from people's eyes. This seemed like a good time to introduce alumni/ae to this new telephone system you may have already encountered, and in so doing to give MIT grads an early glimpse of the future of telephone systems.

At the heart of the MIT's new system is the 5ESS switching computer (*"the switch"*), and its arrival on MIT's campus is notable for a number of reasons. For one thing, it is AT&T's very highest high-tech product, the most advanced switch on the market today. For another, it's wholly digital, which means MIT now boasts a greater degree of digital interconnectedness than most of the rest of the world. And third, it is *owned* by MIT, instead of by the telephone company.

All of which does make it notable, but not entirely novel. The 5ESS is also in use at several other sites, including the central offices of many regional telephone systems. Several are owned by private companies. (Merrill Lynch in New York, for instance, Boeing in Seattle and Wichita, United Technologies, Duke, USC, and the Lawrence Livermore Laboratories.)

What does make the MIT system unique is that it is also all in accordance with ISDN codes—the international Integrated Services Digital Network standard to which telephone systems around the world will eventually adhere, providing digital interconnectedness on a global scale. The MIT system is, in fact, among the very first in the world that are up to ISDN standards. It is the only one to combine ISDN software with the 5ESS switcher. And it is the only one to do any of that on such a large scale.

To appreciate the dimensions of the task, consider a few numbers. The installation of the system involved the running of 3 million feet of optical fiber cable, 5,000 miles of copper wire, and a total of 18,000 miles of outside copper cable. So much new cable was laid, in fact, that MIT's underground system of tunnels and ducts had to be expanded. There were more than 13,000 new or replacement telephones installed, and more than 1200 trunk lines to be connected. And as long as there were technicians all over the Institute anyway, the work on the telephone system was combined with planned extension of the fiber-optic backbone of MIT's wide-area network.

For all that, the new wiring is actually simpler than the old. Whereas the old contelephones required as many as 75 to 100

SCOTT CAMPBELL has taught writing at MIT and is the author of Widowers, *a collection of oral histories.*

ILLUSTRATION: JONATHAN SCHNEIDER

pairs of wire, even the most elaborate of the new sets uses a maximum of 3 pairs of wire—a fact that is considered one of the key technological advances of the entire system. This change is possible because a lot of the system's capabilities are handled with software now, instead of hardware. The new wiring is also cheaper and easier to install and to operate.

The new system also runs self-diagnostic programs to a greater extent than the old one, which makes it easier to maintain. When it discovers a problem, the sytem will send a signal as far as White Plains, N.Y., until it locates a human operator who can take remedial action. The system also has a backup power system of its own, separate from MIT's generators, which will keep it running for up to an hour. After that, at least part of the system can be kept going for as long as eight hours on MIT's general backup. (That capability was tested out successfully last February during a power failure in Cambridge.)

Anyone familiar with large, complex systems could have predicted that the installation of all this technology would not go off without a hitch. It didn't. The major headache was caused by the realization, rather late in the game, that some 900 phones were so far away from their nearest switching sites that they required special circuit packs. Once all those phones had been located and extensively rewired, the full operation of the system had been delayed for several months.

But that was just the major problem; there were also fleets of smaller ones. Like the fact that all the manholes filled up with water during high tide, and the discovery of large amounts of asbestos that had to be removed from walls that were being rebuilt. Then there was the problem of having to cross a railroad right-of-way, a task that involved digging down through a thicket of underground pipes and cables so dense that the laborers couldn't even be seen once they dug beneath them. And then, of course, there was the circus parade. All digging was stopped while the parade went from the railroad siding adjoining the campus, down Vassar Street, and on to Boston Garden.

But when all the dust had finally settled, every single work space on campus—and every living space, as well—had been completely rewired. Now, just about anywhere you sit at MIT has two outlets: one for use as a telephone jack, the other for tapping into local-area computer networks. These local computer networks—which can be configured and reconfigured as work and work partners evolve and change—can also be connected to the campus-wide Athena network, and through that to computers at other academic institutions. Computers can be plugged into the telephones themselves to reach outside dial-up services such as CompuServe and Dun & Bradstreet. And data can even be sent and received through a radio antenna on the top of MIT's Green Building, should anyone ever need to.

In most systems, computer data and telephone conversations have to be sent through separate links. But now at MIT, computer data can be sent through the telephone's wires at the same time the phone is in use for a conversation—sent either to the person with whom the caller is speaking, or elsewhere.

Shopping list:
3 million feet optical fiber cable
5,000 miles copper wire
18,000 miles outside copper cable

But that is not even half of the system's new capabilities, because MIT also opted for a lot of bells and whistles. Like a two-digit intercom option, which gives everyone the potential to connect with 99 different parties through a two-digit code, instead of the old one-digit intercom system that allowed nine connections. There is an extended capability for the packet-switching of voices and data, a Voice Mail telephone answering service, and a modem pool through which Institute hardware can communicate with the analog systems that still abound in the rest of the world.

Of all the bells and whistles, though, the toy of preference around here seems to be the incoming call display—essentially a built-in wiretap by which an incoming caller's number is displayed on the telephone's screen. It not only gives users the chance to gather their thoughts for the upcoming conversation, it also gives them the chance to avoid the conversation altogether by letting the call bounce to Voice Mail or a central answering service.

Right now the incoming call display only functions among campus phones, but eventually it will apply to calls coming in from off-campus. Still further in the future, it is expected that this display will show not only the telephone number from which the call is being placed, but also the *name* of the person to whom that number is assigned.

For all these slick features, though, there are some the system does *not* offer, in spite of what people say. The ability, for instance, to reprogram the entire system from any phone on campus. While that rumor probably stemmed from the fact that it is, in fact, possible to do *some* programming tasks from any phone, only one of those tasks results in any changed capabilities—turning on the speakerphone. And only the phone from which you're calling can be reprogrammed on that call. (Speakerphone is a feature that picks up callers' voices from anyplace in a room instead of simply through the handset. It enables a user to operate a photocopier and talk on the phone at the same time, for example.)

Another feature the system does *not* offer, AT&T assures us, is the ability to bug any room at the Institute from your phone. That widely quoted rumor may have had its roots at the President's House, when Priscilla Gray discovered that it was possible, through the speakerphone, to overhear a conversation in another room. Even though she made her discovery months before the new system went in, and even though the equipment involved weren't even the new ISDN phones, and even though once the glitch was discovered the equipment was replaced, still the rumor persisted.

What can occur—and what accounts for some of the fanciful speculation, no doubt—is that one person can cut in on another's conversation if they both have an extension in common on a multi-line phone. And when that happens on a speakerphone, it sounds like the room is bugged.

While that sort of inadvertent picking up on someone else's line could easily happen with the older systems as well, the new system actually has some fancy features to minimize that risk. In fact, it is possible to program the circuitry in such a way that when a line is in use, no one else can gain access to it at all.

So the myths of the Orwellian telephone are being laid to rest. There is one thing, however, that some of us still aren't entirely used to, and that is all the options that are suddenly available, especially on the Voice Mail system. Press one to do this, press two to do that, press three, press four, press on and on—it can be a little daunting. Alumni/ae shouldn't be entirely surprised if they call into campus and get a message like this, recorded soon after the new system came on-line by one of our frustrated faculty: "Welcome to the Twilight Zone of the Telephone—MIT's Voice Mail System, an electronic maze into which you have just stepped and from which you may never escape. Please leave me a message. Good luck." □

Risk-takers and Visionaries:
Builders of the Economy

When a Bank of Boston report came out in June showing that the entrepreneurial alumni/ae of MIT had founded 636 companies now doing business in Massachusetts, it was verifying a reality well known and recently celebrated within the MIT community.

The economics department of the bank did combine a lot of impressive data and thoughtful analysis into a readily accessible format. For example, companies founded by MIT alumni employ more than 192,000 Bay Staters and generate $10 billion in income throughout the state. Worldwide sales for these companies exceeded $39.7 billion in 1988.

The report, "MIT: Growing Businesses for the Future," said that the economic activity of these companies generates at least another 108,000 jobs, for a total of 300,000 jobs statewide.

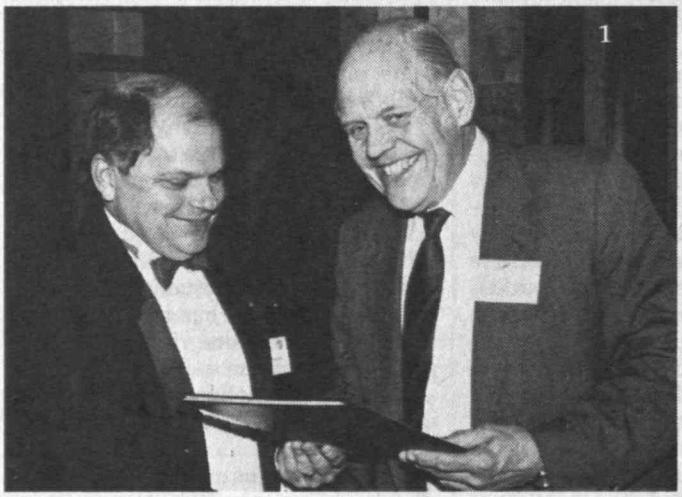
Noting that firms created by MIT alumni in the 1950s and 1960s foreshadowed later economic developments, the report said this about present and future developments:

"Advances in biotechnology and the medical sciences based on MIT research, with the subsequent creation of biotech companies in the early 1980s by MIT alumni, also may be 'foreshadowing' an important new industry for the state and the region.

Although there has been much said and written recently about a dimming of the "Massachusetts miracle," the report notes that 35 percent of the firms founded by MIT alumni were launched since 1980—20 of those companies in biotech alone.

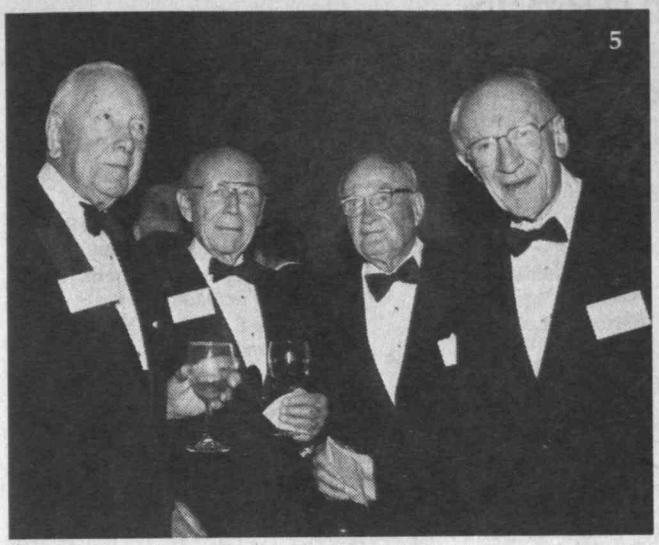
MIT marked the achievement of its entrepreneurs with a lavish dinner in Boston last spring honoring the founders of 99 of the largest companies in the state. Many of them, in fact, had founded several companies. Collectively, this group of business leaders created 100,000 jobs in Massachusetts and 250,000 jobs worldwide. Their cumulative annual sales are $25 billion.

The oldest of the founders were Robert C. Sprague, '24, who in 1926 founded Sprague Electric, which generates more than $500 million in revenues, and Harold "Doc" Edgerton, '27, who co-founded EG&G in 1947 with two MIT colleagues, Kenneth Germeshausen, '31, and Herbert E. Grier, '33. The youngest were Ms. Pac Man creators Douglas Macrae and Kevin Curran, both Class of '81, whose GCC Technologies, Inc. began as a video-game concession they ran with John Tylko, Jr., '79, in an MIT dormitory. □



1 *Bill Poduska, '59, (left) presented a founder's award to Ken Olsen, '50. Between them, the pair have founded four computer companies. They both know what it's like to start out rehabbing a dingy office—at the same time you're designing and building a new machine—and wind up with a company on the Fortune 500 list.*

PHOTOS: J.D. Sloan



2 *Ray Stata, '57, (right) presented a founder's award to Martin Trust, SM '58, who in 1970 started MAST Industries in part, he says, because "I needed a job!"*

3 *By now it's a well-told story in the computer trade that Patrick McGovern, '59, built a tic-tac-toe-playing computer that helped him win a scholarship to MIT, where he studied the workings of the human brain and was sports editor of* The Tech. *Then he put his background in computation and publishing to work by founding the International Data Group, which now controls 25 percent of the computer publications market.*

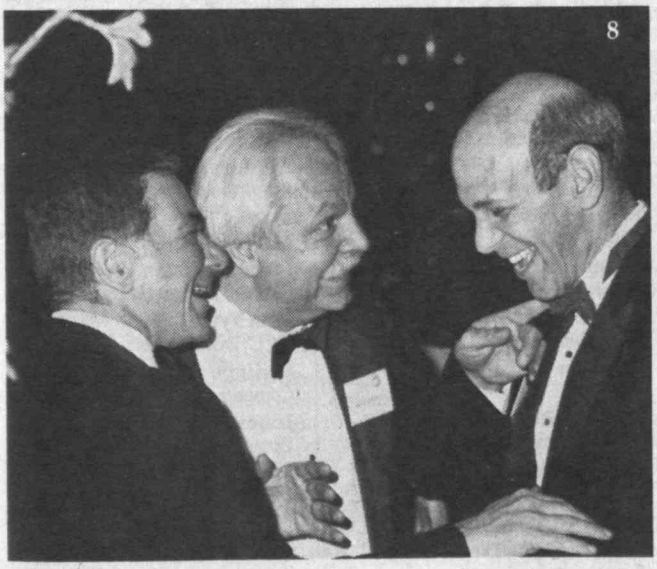
4 *After holding forth with wit and energy as master of ceremonies for the "founders dinner," Alex d'Arbeloff, '49, with his wife Brit-Marie, SM '61, was free to join in the dancing in the magnificent lobby of 75 State Street, the latest landmark developed by The Beacon Companies, headed by Norman Leventhal, '38. Quipped d'Arbeloff, "Based on annual sales revenues of $25 billion, the companies represented here tonight will sell $3 million worth of products while we are eating dinner."*

5 *Even in a room full of giants of entrepreneurship and technical education, this cluster stood out: (l to r) President Emeritus Julius Stratton, '23, Harold "Doc" Edgerton, '27, Cecil Green, '23 (a founder of Texas Instruments and one of the evening's keynote speakers), and Kenneth Germeshausen, '31.*

6 *Samuel Bodman, ScD '65, (left) chairman and CEO of Cabot Corp., and Anne Baddour, wife of Raymond Baddour, ScD '51, were participants in the glittering tribute to company founders like William Koch, '62 (right).*

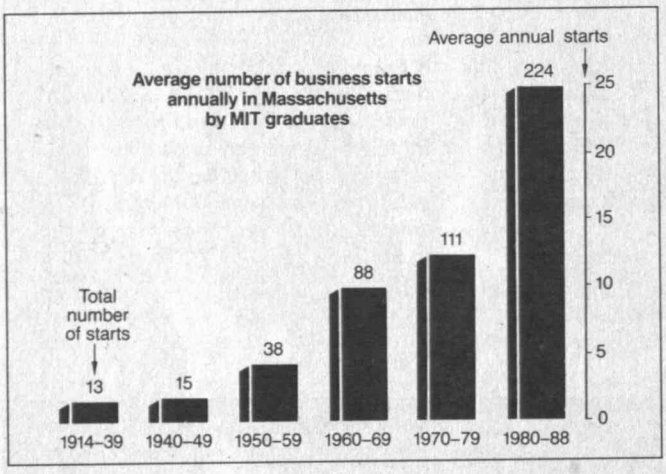
7 *J.P. Barger, ME '56, presented a founder's award to Renata Cathou, '57, whose latest company, Technical Evaluations, is one of the pioneering firms in the field of biotechnology.*

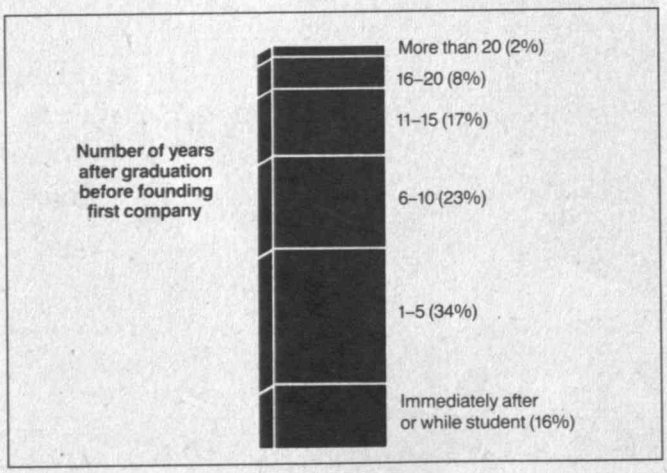
8 *Entrepreneurs like Jerome Grossman, '61 (left), Neil Pappalardo, '64, and Edward Linde, '62, clearly enjoyed the opportunity to get together; conversations were so absorbing that it was hard to coax the guests from the reception to dinner, difficult again to coax them from dinner to dancing.*



99 Massachusetts Founders

Clark C. Abt, '51
ABT Associates, ABT Books
Mark S. Ain, '64
Kronos
Harl P. Aldrich, Jr., '47
Haley & Aldrich
John S. Anderegg, Jr., '49
Dynamics Research
Jack A. Arnow, '50
Interactive Data
Raymond F. Baddour, ScD '51
Amicon
J. P. Barger, ME '56
Dynatech
Mel A. Barkan, '55
The Barkan Companies
George M. Berman, '45
Unitrode
Amar G. Bose, '51
BOSE
David A. Boucher, '73
Interleaf
Eugene P. Brandeis, '54
Computer-Link
Pierre J. Brosens, '55
General Scanning
Harold Brown, '47
Hamilton Realty
George S. Burr, '41
Instron
Gordon J. Burrer, '55
Inframetrics
David A. Cane, '69
MASSCOMP
Richard A. Carpenter, '64
Index Technology
Renata Egone Cathou, '57
Clinical Assays
James A. Champy, '63
Index Group
Neil J. Colvin, '70
Phoenix Technologies
William E. Cook, SM '74
Signal Technology
Kevin G. Curran, '81
General Computer Corp.
Alex V. d'Arbeloff, '49
Teradyne
Robert L. Daniels, SM '66
PSDI
Harold E. Edgerton, '27
EG&G
Steven G. Finn, '68
Bytex
James H. Flanders, '53
Intermetrics
Norman E. Gaut, PhD '67
Picturetel
Arthur Gelb, ScD '61
TASC
Kenneth J. Germeshausen, '31
EG&G
Thomas P. Gerrity, Jr., '63
Index Group
Donald T. Goldberg, '54
Goldberg-Zoino & Associates
Bernard H. Goldhirsh, '61
Goldhirsh Group
Jerome Goldstein, '60
Advanced Magnetics
Bernard M. Gordon, '48
Analogic
J. Michael Greata, '63
Apollo Computer
Jerome H. Grossman, '61
Meditech
Arturo J. Gutierrez, '61
The Gutierrez Company
Thomas G. Hagan, '51
Camex
Sheryl L. Handler, PhD '85
Thinking Machines
George Hatsopoulos, '49
Thermo Electron
W. Daniel Hillis, '78
Thinking Machines
Harold Hindman, '39
Instron
Norman A. Jacobs, SM '59
Amicon
Thomas O. Jones, '66
Epsilon
Mitchell Kapor, '81
Lotus Development
Andrew S. Kariotis, '54
Alpha Industries
Michael D. Kinkead, '66
Saddlebrook
Aaron Kleiner, '69
Kurzweil Companies
William I. Koch, '62
Oxbow
David I. Kosowsky, ScD '55
Damon Corp.
Richard H. Krock, '59
Wedgestone Financial
Raymond C. Kurzweil, '70
Kurzweil Companies
Allen Latham, Jr., '30
Haemonetics
Harry B. Lee, '57
Atlantic Aerospace Electronics
Shih Y. Lee, ScD '45
Setra Systems
Richard S. Leghorn, '39
Itek
Norman B. Leventhal, '38
The Beacon Companies
Y. T. Li, ScD '39
Setra Systems
Laurence S. Liebson, SM '79
Xyvision
Edward H. Linde, '62
Boston Properties
John D. C. Little, '48
Information Resources
Matthew Lorber, '56
Analog Devices
Fred L. Luconi, '64
Index Group
Douglas B. Macrae, '81
GCC Technologies
Thomas Marill, PhD '56
Computer Corp. of America
Solomon M. Max, EE '61
LTX
Patrick J. McGovern, '59
International Data Group
David James McGrath, '59
TAD Technical Services
John E. Miller, SM '53
Intermetrics
Jean I. Montagu, '55
General Scanning
Otto Morningstar, PhD '39
Costar
Kenneth H. Olsen, '50
Digital Equipment
A. Neil Pappalardo, '64
Meditech
Philip E. Perkins, '66
LTX
J. William Poduska, Sr., '59
Prime Computer
Peter N. Rigopulos, '54
Amicon
Edward B. Roberts, '57
Meditech
Denis M. Robinson, SM '31
High Voltage Engineering
Jorge E. Rodriguez, '60
SofTech
Douglas T. Ross, SM '54
SofTech
Lindsay Russell, '50
Adams-Russell
Jonathan M. Sachs, '70
Lotus Development
Howard C. Salwen, '58
Proteon
L. Dennis Shapiro, '55
Aritech
Richard N. Spann, '61
Applicon
Charles H. Spaulding, '51
Spaulding & Slye
Robert C. Sprague, SM '23
Sprague Electric
Raymond S. Stata, '57
Analog Devices
John F. Taplin, '35
Bellofram
Stephen C. Taylor, '66
Saddlebrook
Martin Trust, SM '58
MAST Industries
Victor M. Tyler, II, '55
Concord Computing
John Tylko, '79
GCC Technologies
Philippe Villers, SM '60
Computervision
James L. Waters, '46
Waters Business Systems
John S. Wurts, '70
Management Decision Systems
William S. Zoino, '54
Goldberg-Zoino & Associates





CLASS NOTES

16

We regret to report the deaths of three of our classmates: **Henry Pinkham** on November 28, 1988; **Philip O'Keefe** on February 19, 1989; and **Alfred Nibecker** on March 29, 1989. Notification was received from family members. Al Nibecker's son wrote: "Dad always treasured the time he spent at MIT. He had nothing but good things to say about the institution and those he met there. He also developed a taste for baked beans that lasted a lifetime. As you may know, Dad was a fine architect. But more than that, he was a person of unquestioned integrity and a great husband and a wonderful father to all of us." May Henry, Philip, and Alfred rest in peace.

In 1966, as part of our 50-year class gift, the Hugh Hampton Young Memorial Fund was established, and has been administered by members of the class of 1916 for many years. **Barney Gordon**'s son, Gene, and **Paul Duff**'s son, John, are two of the present trustees. Barney and Paul attended most of our reunions and were major contributors to the wonderful entertainment at these events. Barney is a great singer, and Paul tells humorous stories. In a recent conversation with Barney's son, John, he informed me that there have been four generation of Dr. Duffs in Massachusetts in the last 103 years. The first was Paul's father, Dr. John Duff in 1886, followed by our classmate, Dr. Paul Duff, followed by his son, Dr. John Duff; and in 1986, his son Gregory became a doctor. The latter two continue their medical professions. Paul's widow, Frances, is a very happy observer of this medical history and visits around the country with her many children, grandchildren, and great-grandchildren. They continue to be an extraordinary family and the class of 1916 continues to be a great class.—**Bob O'Brien,** Acting Secretary, 25 Keith Rd., Pocasset, MA 02559

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I had a long telephone chat with **Ray Brooks** today (June 23). I'm 20 years his junior, yet the traveling he does would exhaust me. We talked about his World War I plane which I had seen the last time I was at the Smithsonian. But much of Ray's comments were in praise and gratitude for his good friends who fly him around the country—Mesa, Ariz., to the Champlin Museum (headquarters for the American Fighter Aces Assoc., founded by Aces of World War II, but including their counterparts of your "war to end all wars"). Other places have been Scotsdale; Lakeland, Fla.; and Oskosh, Wis.

To raise money to expand the Museum at Mesa, Ray and his two buddies were each asked to autograph 1,250 souvenier lithographs. That's a lot of signing for a guy practically blind! He has only 450 more to go to make his quota. But if he can still fly his friend's Cessna plane, I guess he'll finish his share of souvenir autographs shortly.

Now for the news no Secretary likes to include. Our classmate, **Arthur E. Gilmour,** passed away over a year ago. Arthur was in mechanical engineering at MIT, although he did not continue for his degree at the Institute. I checked in my Alumni Registers back through 1930. For many years he had his own company. Although living in the Union Mission Nursing Home in Haverhill at the time of death, you'll be interested that even though Arthur was not a graduate with our Class, he was contributing to our 1917 Class Memorial Fund.

That's it for now. Won't you call or send me any news of yourselves?—**Don Severance,** '38, Acting Secretary, 39 Hampshire Rd., Wellesley, MA 02181

18

I was very pleased to receive a telephone call from **Charlie Tavener** in Boca Raton, Fla., just to report that he is in good health and is busy promoting Boca Raton as secretary of the Chamber of Commerce. More power to him, and isn't Boca Raton lucky to have him giving of his energy and talents. . . . I also received a note from **Bill Jones** of Omaha, Neb., with a copy of a petition on religious rights addressed to the President of the United States.

Technology Day has come and gone. The Cardinal and Gray Society which is an outgrowth of our class reunions is becoming more and more active, with a special program on that day. The following day, June 10, there was a meeting at Endicott House in Dedham and another opportunity to renew old friendships. The featured speaker was a most interesting undergraduate who participated in the design of the Daedelus.

I record with sadness the deaths of two classmates: **George W. Thomas** of Natick, Mass., on January 28, 1989; and **Howard M. Cyr** of Palmerton, Pa., on April 21, 1989.

I am indebted to Howard's son for the following summary of his career. Howard was a chemical engineer in the Metallurgical Research Department of the former New Jersey Zinc Co.in Palmerton for 42 years before retiring in 1961. In 1955, he and two associates received a patent for the improved production of titanium tetrachloride, which was assigned for production at the zinc company. He was a veteran of World War I, president of both the Palmerton Memorial Park Association and Palmerton Board of Trade, founded the Palmerton Camera Club, and was trustee of the American Chemical Society, Lehigh Valley Chapter. He wrote many articles for the former Mekeels Magazine.—**Max Seltzer,** Secretary, 519 Washington Street, Brookline, MA 02146

19

On Technology Day, June 9, 1989, in cooperation with the Alumni Association, MIT Class of 1919 conducted a special one-day 70-year reunion of its classmates. We attended a ceremony held at Class Day luncheon along with the other classes. Our tables were located directly in front of the speakers forum, and President Paul E. Gray welcomed us to the occasion. He complimented us on our activity in making it the first 70-year reunion, and declared it to be an honor to have done it. It was an impressive event.

There were five classmates and seven guests present at the reunion: **Donald D. Way** with his wife Barbara and son Peter, **George Michelson, Alan H. McIntosh** with his son, **Douglas Burkett** with his wife, daughter, and granddaughter; and **Wilfred O. Langille** with his wife, Florence. We considered this a creditable showing at this late date in our careers. We take this occasion to express our appreciation for the help of the special committee of our class, mainly **Donald Way, George Michelson,** and **Edmund J. (Doc) Flynn** who worked with the writer as chairman. We would also like to express our appreciation for the help we received from the Alumni Association in forming the plan and handling the notifications. Several members of the class corresponded with us concerning the affair. Among these were **Francis A. Weiskittel, Timothy E. Shea, Doc Flynn, Aubrey P. Ames** and **Robert B. MacMullin.** All of them would have been with us if their health had permitted.

We have received from the Alumni Association a report of the deaths of **Oscar A. De Lima** in November of 1987; and **John W. Rogers** on February 27, 1989. With this writing we have no further information on their careers, but we will obtain this and report it at a later date.—**Wilfred O. Langille,** Secretary, P.O. Box 114, Gladstone, NJ 07934, (201) 234-0690

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Valborg Aschehoug of Oslo, Norway, died in March. Information was furnished by her attorney. . . . **Karl Bean** of Yarmouthport, Mass., died in June. He lived in Winchester, Mass., and played the violin in the Tech Show Orchestra. Your secretary was also a member of the orchestra and remembers him well.

Percy Bugbee of Plymouth, Mass., died in May 16, 1989. The following account of his career is condensed from the Boston Globe. He was a pioneer in fire safety and general manager of the National Fire Protection Association for 30 years. After graduation, Percy joined the association staff as its first field engineer. He traveled throughout the country urging improvements in fire protection for homes, offices and factories, and organizing fire prevention committees with help from business groups and fire officials. He became the association's first general manager in 1939. Under his leadership through 1969, the association's membership increased tenfold, and it developed and published standards of fire safety on which all state and local fire codes are based. He was also chairman of the War Department's Advisory Council on Fire Protection during World War II and in the early 1960s helped organize the International Conference of Fire Protection Associations. He was a honorary member of fire safety groups in the United States, Canada, Britain, France and Australia. The Swedish Fire Protection Association gave him its Gold Medal. His

contribution to the 1973 report,"America Burning," led to the creation of the U.S. Fire Administration and the National Fire Academy. His book, Principles of Fire Protection (1978), remains the leading text on fire science in the country. He leaves his wife, Wilhelmina (Ross); two sons, a daughter, a twin brother, and nine grandchildren.

Moses Pike of Lubec, Maine, died on March 13, 1989. Moses was a 1918 U.S. Army veteran, and was Dexter Cooper's assistant on Passamaquoddy Tidal Power Development in the 1920s and 1930s. From 1937 to 1979, he was general manager of Holmes Packing Corp. in Eastport, Maine. He was a leader in the Maine sardine packing industry. He served on the Department of Interior's American Fisheries Committee during the Eisenhower years. He was a member of the International Joint Fisheries Committee for the U.S. and Canada, president of the Maine Sardine Packers Association, and a member of the Maine Sardine Council. He also served on the Lubec Water and Light Board, was town meeting moderator, and was a member of the American Legion. Survivors include two daughters, and three grandsons.—**Harold Bugbee,** Secretary, 313 Country Club Heights, Woburn MA 01801

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In a phone call to **Helen St. Laurent,** I learned that she is getting along with a cane these days. She plans to spend the summer at her cottage in Center Lovell, Maine. . . . Maxine and **Cac Clarke** had a great visit with their daughter Ellie out in Oregon. They went both ways by train. "A wonderful way to travel!" says Cac. The Clarkes also attended Technology Day and reported that **Frank Whelan** was the only other member of the class on hand. They sat at a combined table for 1918-1923. Cac reports that he talked to **Helier Rodriguez** in Tampa who is not doing too well healthwise. . . I received a copy of a letter from **Albert Genaske** to Cac Clarke. He writes, "Since graduation I was with the Boston Planning Board for two years and then had a temporary job with the MDC for 44 years. I ended up as a contract engineer, covering the writing and execution of some 300 contracts of the Quabbin Reservoir and the Metropolitan Sewage System. My hobby was photography. I became a lecturer of the state and spent much time travelling. I lost two lovely wives, the first one after 30 years and the second after 19 years. I am a semi-invalid living in my own home with some health care."

Two death notices were received this month: **Goodman Mottelson** of Chislehurst, Kent, England, on September 8, 1988; and **Chesterton S. Knight** of Brockton, Mass., on May 6, 1989. Chick Knight served on reunion committees with **Donald Morse** and was a classmate of your secretary's at Brockton High School, class of 1917. Chick was a shoe machinery inventor and manufacturer. He designed many innovative machines for making shoes and had a number of patents. Our condolences go out to the families of these two men.—**Sumner Hayward,** Secretary, Wellspring House, E64, Washington Ave. Ext., Albany, NY 12203; and **Samuel E. Lunden,** Asst. Secretary, 6205 Via Colinita, Ranchos Palos Verdes, CA 90274

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Your secretary over the past year has been corresponding with President Gray and William J. Hecht, executive vice-president of the Alumni Association, as to whether it would be to the advantage of MIT to invite all alumni who have passed the 65th reunion date to attend Technology Day as guests of the Institute. The average minimum age of such invitees would be 87. Considering the small percentage of such "old guard" alumni able to attend, the cost to MIT would be slight but the good will engendered among the survivors would be great. Your secretary has seen the success of such a plan at Andover, where all alumni who have passed the date of the 65th reunion (average minimum age 83) are invited to Alumni Day each year as guests of the school. Attendance is two-thirds of those invited. The cost to the school is negligible. If you think well of the idea, drop a note to Mr. Hecht at the Alumni Association.

At Technology Day last June, the class of 1922 was represented by **Marjorie Pierce,** Muriel and **Ted Miller,** and me. The memorial service in the Chapel honoring those deceased in the past year included 28 from 1922. The luncheon in the Athletic Center was, in golfing terms, somewhere between a bogey and a double bogey. I'll spare you the details. However, enthusiasm won the day. Gifts by classes reached new levels.

The Institute has just published a new register entitled MIT Alumni/ae Register 1989. It contains the names of over 100,000 living alumni/ae and upwards of 30,000 deceased. Included also in the volume are the customary listings by class and by location. The following comments concerning the Register may be of interest to some members of all classes. Those of us who over the years have chosen to be identified by our middle names and have been so listed in all previous registers will now find that our names, without our authorization, have been changed to read first name, middle initial, and surname. A few examples from 1922: **George Dandrow,** the 55th president of the Alumni Association, is now in the deceased section as Charles G.; **Yardley Chittick** is Charles Y.; **Dewey Goddard** is George D.; **Raymond Hewes** is Walter R.; **Ross Wiggs** is Henry R. Other instances from other classes: D. Reid Weedon, '41, the 68th president of the Alumni Association, is Daniel R. Weedon,; E. Milton Bevington, the 91st president of the Alumni Association, is Edmund M. Bevington; and a life member of the corporation, J. Kenneth Jamieson, '31, is now John K. Jamieson. In the living-alumni section of the register, there are no middle names. The only alumni retaining the first-initial style are those who were listed as deceased in the 1984 and previous registers. For example, M. Gordon Smith, '23, who died prior to the 1961 Register, is still M. Gordon Smith in the deceased section of the 1989 Register. I think the Alumni Office should give a public explanation regarding this impropriety, and offer a formal apology to each person involved.

Thomas B. Stewart, Jr., Course I, died in 1988 in Belmont, Calif. I have no information about his family or career. . . . **Walter C. Pew,** age 87, died March 14, 1989, in Bryn Mawr, Pa. He was the grandson of the founder of the Sun Oil Company and a director of the company for more than 40 years. His long career in the oil industry and his other good works have been covered in a previous edition of the *Review.* While at MIT, Walter was a member of Delta Psi, but I could find no mention in any of the *Techniques* of his engagement in any undergraduate activities. He more than made up for it later.—**Yardley Chittick,** Secretary, 1922 Rte. 1, Box 390, Ossipee, NH 03864

23

A weather expert I am not. But you will note that in the last two or three class notes I have made reference to the weather in southern New England. Here we go again. After a dry winter, the rains came and all ponds and reservoirs are full and overflowing, assuring this area of the country of sufficient water supply, certainly to the end of the year.

Now for a little class business. A short time ago our president wrote saying he and "Doc" Smith had been discussing the possibility of an off-year class reunion next winter in Florida. This might be a good idea because, you know, "time's a flying" and also a five-year reunion is quite a long time at this stage of the game. Also, there are undoubtedly many of the class living in Florida who couldn't come to the Boston area. Let's have your comments soon with your length of time and so on.

Your secretary has recently received a clipping from the Stanford University *Observer* honoring **Cecil Howard Green** and Ida Green for their philanthropies. Cecil received the degree of the "Uncommon Man" from the Stanford Associates, a degree given to only 16 individuals since its creation in 1953. Honored with the degree posthumously was Green's wife, Ida M. Green, who died in December 1986.

The Greens are the first non-alumni to receive the award. The degree is based on Herbert Hoover's statement that "we believe in equal opportunity for all, but we know this includes the opportunity to rise in leadership, in other words, to be uncommon." Cecil earned his S.B. and S.M. degrees at MIT and Mrs. Green was a graduate at Southern Methodist University.

Your scribe received a letter from an MIT graduate, Chuck Lawrance, '42, who worked closely with him in the Connecticut Sanitary Engineering Bureau a number of years ago. He is now a partner in a California consulting firm of Lawrance, Fish and McFarland.

A letter was received recently from Mrs. Regina Fitzgerald, wife of **Jerry Fitzgerald,** who died July 3, 1988. He was a "giant" in the processed food industry, receiving honors from many sources. A few agencies to which he was connected were Birds Eye, Richards & Robbins Co., the U.S. government, Frozen Food Foundation, Pepperidge Farm, among many. A note on his death appeared in the January 1989 *Review.*

Your present secretary also has been in touch with your former scribe. He is in good health and except for a slight difficulty in walking is enjoying the good life. Best regards, Dick, to you and your good wife.—**Frederick O.A. Almquist,** Secretary, 63 Wells Farm Dr., Wethersfield, CT 06109

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At the 65th reunion, **Col. I. Henry Stern** was elected class secretary, and **Richard (Dick) Shea** was elected president. Dick is still assembling his team, of which more will be reported later. To date, Katherine (Mrs. **Rockwell) Hereford** has agreed to become acting class secretary. Please send your news so that your classmates may learn of your activities.

We regret to report the deaths of six more classmates. **James F. Crist** of Atlanta, Ga., died December 28, 1988, of Parkinson's disease. Crist had a long career working for power companies in Alabama, South Carolina, and Georgia from 1927 until retirement in 1966. He joined Alabama Power Co. as an apprentice lineman in 1927 and later became a sales representative. In 1929 he was employed by South Carolina Power Co. as a power sales engineer and during his 19 years with the company rose to executive vice-president. He helped to establish the Southern Co. uniting four power companies in 1947 and was the author of the book, *They Electrified the South.* He remained as an advisory director of the Southern Co. until 1977 and was also on the boards of the Louisville and Nashville Railroad and the Seaboard Coastline Railroad and was a former board chairman of United Trust Life Insurance Co., in addition to his advisory capacity to several electric companies. The president of the Southern Co. honored Crist saying, "Much of the prosperity the South now enjoys is directly attributable to his long and untiring efforts." James Crist is survived by his wife Elizabeth, two sons, a daughter, a sister, five grandchildren and one great-grandchild.

A. Alfred Franks, of Brookline, Mass., died April 6, 1989, in Palm Beach, Fla. He was the founder of the Clinton Clothing Co. He is survived by his son, daughter, brother, two sisters, and six grandchildren. . . . **Wilbert M. Gilman,** of Wellesley Hills, Mass., died March 30, 1989.

Gilman was a design engineer who worked on mechanical and hydraulic engineering projects for Raytheon Co., Jackson and Moreland of Boston, High Voltage Engineering Corp. of Burlington, and others before retiring in 1978 from W.H. Nichols Co. of Waltham. He was a member of the Appalachian Mountain Club. Gilman is survived by his wife Mary, a daughter, son, and grandson. . . . A note from the niece of **Frank J. Hecht, Jr.**, of Tall Timbers, Md., reports his death on June 10, 1988. She writes that he passed away at home, having never spent a day in the hospital during his life. "We will miss him, he was a gentle man."

Richard Lamborn of Erie, Pa., died May 7, 1989. At MIT he earned bachelor's and master's degrees in electrical engineering and worked in that capacity at General Electric for 45 years, serving as manager of the Motor and Generator Engineering Department of the Transportation Division. Lamborn developed the low flux 25-cycle single phase traction motors which were the basis of the Pennsylvania, Reading and New Haven Railroad electrifications. He also helped develop direct current generators used on diesel-electric locomotives and during World War II, made significant contributions to the U.S. Navy's magnetic minesweeper and the Armys' electric drive tank projects. He was a member of the Institute of Electrical Engineers, the Gem City Rock and Mineral Club, the Antique Auto Club of America, an honorary life member of the Erie County Historical Society, and a trustee of the Presbytery Foundation. Lamborn is survived by his wife, Marion, a son, daughter, and four grandchildren. . . . **Perry N. Foster** of Southern Pines, N.C., died March 23, 1989. He was an employee at the American Bosch Co. in Springfield, Mass., for 32 years, and then became a special representative for Robert Bosch G.M.B.H. of Germany and chairman of the company's American subsidiary in Chicago. He retired in 1972 but continued as a director until 1974. He was a member of the Society of Automotive Engineers, and a volunteer at the Westerly Hospital in Rhode Island. He is survived by his wife Selma, a brother, and four sisters.—*ed.*

25 65th Reunion

Technology Day found 1925 represented by **Stanley Lane** and Grace, **Milt Salzman, Sam Spiker, Courtenay Worthington** and your secretary. **Sam and Elinor Spiker** were in Florida last March and while in Naples organized a luncheon with **Baer Connard, Franklin Fricker** and Marion, and **Fred Greer** and Eleanor.

The passing of three classmates must be reported. **Mary Morrison Kennedy** died on June 4, 1989, at her home in Boston. She was in charge of design for the Boston-based Sheraton hotels from 1941 until retirement in 1975. Promoted to vice-president in 1959, she also had served as senior vice-president of Sheraton Design and Development, Inc.

She directed the engineers, architects, and decorators erecting or refurbishing hotels around the world and was responsible for interior design of all the function rooms and bedrooms of the far-flung Sheraton empire. An MIT-trained architect, Mary also had done some interior structural design for the corporation, including the ballroom of the Sheraton in Washington. She held membership in both the American Institute of Architects and the American Institute of Decorators. She won the Good Design Award of the Hotel Furnishers Association. She was made a member of the Order of the British Empire for her work as co-chairwoman of the executive committee of British War Relief in Boston during World War II. She is survived by two daughters, five grandchildren, and a great-granddaughter.

Robert E. Dodd died on January 5, 1989, at his home in Buffalo, N.Y. He had been associated since 1927 with General Plastics which later became Durez Plastics Co., a part of Hooker Chemical Corp. He was was sales manager of Durez and retired in 1962. Robert had been an active member of SCORE (Service Corps of Retired Executives), an organization of volunteers who help small businesses succeed. He was a member of the Country Club of Buffalo, and the Saturn Club, and had served as president of the board of trustees of the Park School. He also had been a vestry member and warden at Calvary Episcopal Church. He is survived by his wife Margaret, three daughters, and eight grandchildren.

Shedd Vanderberg died in Rancho Santa Fe, Calif., on April 27, 1989. No details are available.—**F. Leroy (Doc) Foster,** Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

As vice-president of decorating, design, and architecture for Sheraton Hotels, Mary Morrison Kennedy, '25, had decorated 31,770 rooms by 1962, as well as assisting in the design of new buildings. She experimented with classical and contemporary styles; designed specialty restaurants in international motifs; and furnished Presidential suites with antiques.

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*Editorial apologies to **Leo Taplow** who was in industrial relations in the U.S. Patent Office and friends with **Morris Minsk**—and not **Bill Meehan** who reported this in the 60th reunion class book; and to the class secretary for scrambling this hard sought information in the August/September issue.*

We have had many examples of devotion by Class of 1926 members to MIT. Now we have another: **Morris Minsk** attended Technology Day; including the program at Kresge, Luncheon, and 10-250; he also went to Endicott House in Dedham with the Cardinal and Gray Society. He did it all in a wheelchair—how's that! In addition he brought a beautiful bouquet of silk flowers for me to give to my wife Mary, who was in the hospital. She is at home now.

James L. Suydan of Fennville, Mich., died May 8, 1988. He was general superintendent in large building construction. . . . **Royal Boston, Jr.,** of Southern Pines, N.C., died January 22, 1989. He was a partner of Wadsworth & Boston, architects, in Portland, Maine. . . . **Argo E. Landau** of St. Louis, Missouri, died in January 1986. He was president of Royal Bend, Inc. . . . **Dwight H. Woods** of Kerrville, Texas, died March 1, 1989. He went to Wesleyan University for two years before coming to MIT in 1923. He retired as vice-president of operation of Nashville Gas & Heating Co., Tenn. His hobbies were building and sailing boats and trailering around, then living in their home between trips. He leaves his wife Clemmie.

Peter L. Bellaschi of Portland, Oregon, was written up in the May-June 1989 class notes. He has now sent to William J. Hecht, publisher of the *Review,* considerable printed material full of equations, charts and text. He states: "The need for better science and mathematics in our schools is a must." . . . **Crockett A. Harrison** of Grove City, Pa., writes: "Have just published privately a 500-page book on the family of my late wife, Frannie C. Harrison, who died July 6, 1988. "It is a combination of history, biology, and genealogy of some 40 early New England families, including Mayflower ancestors, early Puritans, and early settlers on the Isle of Shoals, off the New Hampshire coast."

Richard Whiting of 870 U.N. Plaza, New York, writes: "Among other activities, such as music, I have for 15 years recorded for the blind (law and chemistry) and for five years have been a volunteer public school math teacher." Outstanding. . . . **Shantau L. Kirloskar** of Poona, India, was at Technology Day. His wife usually has been with him for his many trips to MIT. She is not well enough to make the trip this year, so he was accompanied by his daughter-in-law. His wife started a business that hires poor women to make bearings for his business, and his daughter-in-law runs it now.—**Donald S. Cunningham,** Secretary, 27 Lowell St., Braintree, MA 02184

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Just a small group attended our June reunion. President **Harold (Bud) Fisher, Richard Hawkins, Ervin Bramhall** from Sun City, Ariz., and **Joseph Burley** attended the luncheon. **Ezra Stevens** and **Lawrence Day** also registered for the reunion. A good feature this year is that older classes were given front row seats at Pops and we enjoyed an excellent concert. A special display behind the Main Lobby was an exhibition of **Harold Edgerton's** pictures from 1927 to the present. "Stopping Time" was shown on about 12 walls, together with his old flash equipment. Hal is again off to Scotland for another try to find the monster of Lock Ness.

At the Memorial Service, it was reported that 24 members of our Class have passed on this year. Our Class now numbers 304 listed in the 1989 Directory. A good record for 85-year-olds!

Thomas Knowles says he and Marion have moved from the beachfront apartment in Naples to 122 Moorings Park Dr. "With all this compacting (of moving), I've had to be pretty ruthless in scrubbing old history-musical clubs and other mementos." After this he advises "Any 'Files' on me can be scrubbed." . . . **Edward Mott** says he is enjoying life in Madison, N.J. He retired from Bell Labs in 1969 after 40 years service on telephone receivers of advanced design and underwater sound instruments for the U.S. Navy. Ed, is your electric cart still running around town?

We regret the long delay in reporting the death of **Edward Jones** on July 4, 1988, in his son's home in Wheaton, Ill., of cancer. He had lived in Rancho Bernardo, Calif., and pursued electrical engineering throughout his career. . . . **Dudley S. Young** died on December 12, 1988, in Toronto, Canada. He received his MS at MIT in 1927 and came from Souris, Manitoba, Canada. **John D. Kuhns** died on February 5, 1989, age 89, in Springfield, Ohio. He was a graduate of Wittenberg University in 1921 and received a BS in architectural engineering at MIT in 1927. He was one of the earliest broadcasters for WBZ in Boston. He was given the honor of becoming a 33rd Degree Mason. He founded the Kuhns Concrete Co. to produce ready-mix concrete. After selling the business in 1968, he continued to operate it for the new owner, retiring in 1972. During the past 10 years, John had been active on the board of directors of First National Bank, Community Hospital, and Wittenberg University; and was a member of several social Clubs.

Robert J. Dorey died on March 4, 1989, in Wayland, Mass. He worked his entire life in the area of laboratory supply sales, starting with the

PHOTO: BRADFORD BACHRACH

Howe and French Co. in Boston. He founded the Industrial and Scientific Instrument Co. in Wayland and retired in 1965. Bob was a member of American Chemical Society, the Instrument Society of America, and the Cocker Spaniel Club of America. . . . **Richard P. Innerasky Jr.** died on March 15, 1989, in Dennis, Mass., of congestive heart failure. Following graduation he entered the Navy as a lieutenant and served until the end of World War II. He moved to Harwichport in 1950 and opened his own real estate business and also worked as salesman for Sears, Roebuck. He moved to Yarmouthport in the 1960s and later moved to Dennis.

Col. William P. Berkeley died on April 8, 1989, in Cazenovia, N.Y. He suffered from Alzheimer's disease after an active life. At MIT he was captain of our hockey team and elected class treasurer in his senior year. He received M.Ed. degree from Harvard Graduate School of Education.

Bill was commissioned a first lieutenant in May 1942 in the US Air Force. After training he went overseas on the *Queen Mary* to England in September, 1942. With B-17 groups in early days there, then 1st Air Division as aide de camp to the Commanding General, 8th Air Force, from January to July 1943. He was chief of statistical (operations) control until November 1943. He moved to headquarters AAF spending most of his time on policy for the Combined Chiefs of Staff. He received the Legion of Merit with Oak Leaf Clusters.

In post-war duties, he was three years on the faculty of the Industrial College of the Armed Forces in Washington. From 1952-1956 he was stationed in Tokyo with the Far East Air Forces as a logistics planner and assistant deputy for material. In 1956 was assigned to Air Material Command as chief of the plans and requirements division. He retired in 1960. His funeral service was held at Arlington National Cemetery.

We extend our deep sympathy to the widows and families of all these fine classmates.—**Joseph C. Burley,** Secretary, North River Rd., Epping, NH 03042; **Lawrence B. Grew,** Assistant Secretary, 21 Yowago Ave., Branford, CT 06405

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For Technology Day this year, the Institute made a special effort to welcome and accommodate those most senior of alumni, the Cardinal and Gray Society (comprised of members whose classes have been out in the world 50 years or more). A meeting place was provided in McCormick Hall where such alumni, alumnae, and guests could gather for rest, to chat, reminisce, and socialize during the two-day period. On Thursday, T-Day minus one, this venerable red-jacketed group had its own social hour followed by its own pre-Pops dinner (all at McCormick) and a fine evening at Pops. Those requiring housing were accommodated on campus. Technology Day events (memorial service, lectures on space science and exploration, the T-Day Luncheon, afternoon social) were especially well attended. Class of '28 made a very good showing on this occasion with the following members in attendance for at least some parts of the program: **Gabe Disario,** Frannie Donovan, Dorothy Goldberg, **Bill Hall,** Helen Harris, Janet and **Fred Lewis,** Florence and **Walter Smith, Jim White,** Ruth and **Abe Woolf.** We have agreed that the special help and attention given to senior alums worked out very well, was highly appreciated, and should be done again next year.

We have a very good note from **Charlie Southwick** that is best presented in his own words: "Just to bring the record up to date, we have three sons scattered around the U.S.A. Ben, the youngest, is a lawyer in Wisconsin with a fine lawyer wife and no children. Donald is an electronics engineer in Vancouver, Wash. His married daughter has just been granted a full Ph.D. scholarship in molecular biology at Stanford. His son should get a degree in electronics soon. Our oldest son lives in Tucson, is a specialist in electro magnetic signatures, which he tells me is another name for "static." One of his sons has a very successful English language school in Taiwan. After 40 years of living on a lovely property in Hope in western New Jersey, we sold out and moved South. Our home is now a villa that we purchased on Hilton Head Island, S.C. We have been spending winters in Hilton Head for some years. I have one more comment: Course X, under Doc Lewis, really prepared me for the world."

We have also a most welcome note from **Al Gracia** sent with two ancient issues of *The Tech*, different but each bearing the same publication date of June 5, 1928 (our own commencement day). One copy is of the regular issue, the other is a special number devoted entirely to the class of 1928 with pencil sketches of then M.I.T. President Samuel W. Stratton and '28 President **Ralph T. Jope** dominating the front page. Says Al: "If you have not interest in these, just 'chuck' them." (Not a chance!) We'll add these gems to our collection of '28 historical items so you can all enjoy them at our 65th! Thanks, Al.

In our July Notes we reported the death of our esteemed classmate, **Gerry McGillivray.** Shortly after submitting notes for that issue, we received a beautiful letter from Gerry's son, Kenneth, and his (Kenneth's) wife, Una. Our space is limited for the present writing, but we will share with you their very interesting letter in our next issue.

We have had several pleasant telephone conversations with **Eleanor Pepper.** She is very busy these days but well and happy in her work. She emphasizes that women architects have a very important place in that field. Eleanor is planning to provide a modest annual thesis prize (monetary) to be awarded a graduating woman student in the M.I.T. Department of Architecture. Our congratulations and hearty applause for Eleanor!

With deep regret, we must report on two class-related deaths: **Gordon F. Rogers** died January 23, 1989. Gordon graduated in Course XV, business and engineering administration, then received his SM degree in civil engineering. Except for the early years, his professional career was that of a consulting engineer. In addition to wife Blanche he leaves his son Marvin and daughter Helen. . . . We also have received notice that Helen (Mrs. **Joseph C.) Whitcomb** died February 14, 1987. (Joe died in 1974.) To the families of these, our classmates, we extend our heartfelt sympathy.—**Walter J. Smith,** Secretary, 37 Dix St., Winchester, MA 01890; **Ernest H. Knight,** Assistant Secretary, Raymond, ME 04071

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Our 60th reunion has joined the pages of history. Approximately 40 members of our class and their wives attended the event, which included five glorious days of celebration. A full and interesting program was prepared by the reunion committee, chaired by **Vincent (Jerry) Gardner** in collaboration with the MIT Alumni Association. There wasn't a dull moment during our whole stay on the MIT campus with many scheduled tours, luncheons, and dinners, which were enjoyed by all.

Here is the list of those who attended: Kay and **Paul S. Baker,** of Williamsburg, Va.; Doris and **William Baumrucker, Jr.** of Marblehead, Mass.; Helen and **Eric A. Bianchi** of Tequesta, Fla.; Sally and **W. Gordon Bowie** of Oldsteadville, N.Y.; Mary and **Murry M. Brimberg** of Silver Springs, Md.; Willa and **George A. Crandall** of Casper, Wyom.; Joan and **Ralph H. Crosby** of Rumson, N.J.; Helen and **Karnig S. Dinjian** of Arlington, Mass.; Ellie and **Vincent F. (Jerry) Gardner** of Belmont, Mass.; Dorothy and **John Happel** of Hastings-on-Hudson, N.Y.; Isabel and **Jonathan F. McCray** of Heber Springs, Ariz.; Dorothy and **Herman P. Meissner** of Winchester, Mass.; Barbara and **George J. Meyers, Jr.** of Wyomissing, Pa.; **Richard Piez** of San Mateo, Calif.; Marion and **Robert S. Priole** of N. Palm Beach, Fla.; **James C. Reddig** of Webster, N.Y.; Ruth and **James L. Speyer** of Newton Center, Mass.; Esther and **Harold M. Weddle** of San Diego, Calif.; **E. Neal Wells** of Pinelas Park, Fla.; Ethel and **David H. Wilson** of W. Newton, Mass.; and **Chung Foy Yee** of Worcester, Mass. Fran and **Paul F. Donahue** could not attend because of emergency surgery Paul went through a short time before the reunion. **Frank Mead** of Marion, Mass., cancelled out because he lost his wife, Mary, suddenly a month before the reunion.

At the Pops concert Thursday evening, there was a short composition titled, "Cow on the Roof." **Jim Reddig** proceeded to tell us the story about how he and a few other undergraduates put a cow on the roof of one of the dormitories on a Sunday morning in 1927. The story carried headlines in a Boston newspaper, wondering how it was done. Jim told us, "We conceived the idea, but had no assurance of success. We were pulling grass off the lawn in Eastman Court at 6 A.M. when a Cambridge police cruiser stopped and asked what we were up to. 'Just collecting some grass for an engineering project,' was the answer. The police officer scratched his head and went on his way. We took the grass to a field just west of Mass. Ave., where we had spotted some cows grazing. We put a rope around the neck of one of them. Some of us pulled the rope, some shoved the cow ahead and some fed the grass to the cow to entice him to move. It was a H_____ of a job to push the cow over the stairs, pull and heave him, until we got the cow on the roof." Jim was not sure how the cow was brought down later.

Frank B. Stratton of Sarasota, Fla., writes, "We are still healthy and spry enough to average a month of travel each year. We will be going to Venice, Paris, and then to Vermont for a week or two in August or September. I am lucky to be very healthy. My health insurance still costs me lots more than all my medical bills. . . . **David H. Wilson** writes, "I have just celebrated my 81st birthday, but I don't feel my age. I am still working five days a week manufacturing ladies' bras, which I have been doing since 1945 when I got out of the service. Up to now, I have 11 grandchildren, three great-grandchildren and three great great-grandchildren. I don't have any hobbies, so there is no reason for me to retire and go to seed. I like my work, so I might as well keep on working as long as I can."

Gordon R. Williams of Weston, Mass., writes, "Olive and I did not attend the reunion because she is severely handicapped with arthritis and other problems. I also have had some major surgery recently, but I seem to have bounced back. Best wishes to all." He lists gardening as one of his hobbies, and they have two children and two grandchildren. . . . I had a brief note from **Frederic Celler** of Maitland, Fla. He regrets that his health did not permit him to be with us for our reunion. He sent some pictures showing the view from his balcony. He faces due east and can see space shuttles as they rise from Cape Canaveral. He looks out on intercoastal waterways with the natural beauty of unspoiled shorelines, enough scenery for more than a score of dwellings.

A great honor was bestowed upon **Prof. Herman P. Meissner** of Winchester, Mass. In 1986, a chair in chemical engineering was established in his name. On March 15, 1989, it was announced that Dr. Karen K. Gleason of the Department of Chemical Engineering had been named the Herman P. Meissner Assistant Professor of Chemical Engineering. The chair was established by several donors, including Samuel Bodman III, chairman and C.E.O. of the Cabot Corporation who received his ScD at MIT in 1965. Prof. Meissner, a leading authority on industrial chemistry, had been a member of the chemical engineering faculty at MIT since 1940. He received his SB and SM degrees at MIT in chemical engineering in 1929, and his ScD from the University of Frankfurt in 1938. He has written numerous technical papers dealing with thermodynamics, elec-

trochemistry and applied colloids. His text Processes and Systems in Industrial Chemistry (1971) remains in wide use in the field. Prof. Gleason, who received her SB and SM in chemical engineering from MIT in 1982, received a PhD from the University of California in 1987. She has been a member of the MIT faculty since September 1987.—**Karnig S. Dinjian,** Secretary, P.O. Box 83, Arlington, MA 02173, (617) 643-8364 or (603) 926-5363

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As many of you know, **George Nakashima** has for many years produced hand-crafted furniture of his own design in his studio in New Hope, Pa., and in recent years has had exhibits in New York, Philadelphia, Washington, D.C., and Tokyo. From an article in the *New York Times* on May 24 it appears that a house in Princeton, N.J., owned by one of George's principal customers burned to the ground, and in the process more than 100 pieces of George's furniture were destroyed. The only pieces of this collection that escaped destruction were two items on exhibit at the American Craft Museum in New York City. A number of the pieces are irreplaceable because the wood they were made of is no longer available. According to the *Times* article, the Nelson Rockefellers purchased about 200 pieces of George's furniture in the 1970s for their Japanese-style home in Tarrytown, N.Y.

George Wyman's son, George Mead Wyman, a 1962 Course X graduate, is currently president of his MIT class, as well as a vice-president of lotus Development Corp. in Cambridge. His daughter Sallie received a master's degree in social work last May. George and wife Marjorie hope to attend the 60th reunion next year. George had a tumor removed from his bladder last spring, but a later check indicated no recurrence of the problem. . . . Since his retirement from Norton Co. in Worcester, Mass., **Max Wheildon** has continued to lead an active life. He is a member and certified shooting instructor of the National Rifle Assoc., as well as a professional ski instructor at the American Ski School, and has a "little ski lodge" in the White Mountains of New Hampshire. One of his most interesting activities is being the navigator on cruises aboard the tall ship *Sherman Zwicker.* The *Zwicker* was a "dory schooner" that sailed out of Lunenburg, Nova Scotia, to the Grand Banks for cod fishing. Every morning she launched 12 dorys, each carrying 1.5 miles of fishing line with hooks at 10-foot intervals. In the absence of refrigeration, the catch had to be cleaned and salted at sea. The Wheildons live in Framingham, Mass., and have a summer place in Boothbay, Me. Max says he would like to have a classmate visit them at any of their three residences.

Dick Wilson has lived on seven acres in Penfield, N.Y., since 1942. He reports that he keeps busy working on his home, orchard, and garden. Other activities include golfing, skiing, ice dancing, and raising money for MIT and the Rochester Philharmonic. At the time he wrote, Dick was scheduled to attend the wedding of Herm Botzow's granddaughter, Jenifer Botzow, to Dick's grandnephew, Lars Jorrens, whose grandfather was Edward Farrow, a 1920 Course X-A graduate. Dick reminded me that of our five Course X-A classmates who started work at Kodak, he and **Greg Smith** are the only survivors; the others were **Stan Wells, Ralph Peters,** and **Howie Gardner.** Dick is looking forward to attending the 60th reunion next year.

We have a notice that Henrik **M. C. (Hank) Luykx** died on February 19. After graduating from MIT, Hank was successively an instructor, assistant professor, and associate professor at the New York University College of Medicine, teaching biostatics. After 11 years there, he spent several years doing graduate work at Johns Hopkins, followed by three years in the Navy during World War II. After the war he worked for two years as a biometrician with the Atomic Bomb Casualty Commission in Hiroshima. During the last 16 years prior to his retirement in the mid-1960s, he was chief of the Biometrics Division, Office of the Surgeon General, U.S.A.F. Headquarters in Washington. Upon retiring he spent considerable time on his sloop, sailing for the most part on Chesapeake Bay, but also venturing on cruises to Maine, Florida, Grenada, and Venezuela. Hank's wife Barbara died in 1986 after they had been married 53 years. Hank is survived by a son, Peter, who is a professor of biology at the University of Miami; a daughter, Elizabeth, who is a retail store manager in Washington, D.C.; a son, John, who works in hotel management; and four grandchildren.—**Gordon Lister,** Secretary, 294-B Heritage Village, Southbury, CT 06488

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Ed Worden, our faithful and long-serving class secretary has had a massive heart attack. This was in April and as I write this (**John Swanton,** your assistant secretary but chiefly class agent) in June, Ed's wife Helen tells me that it was so severe it's a marvel he lived, but he is now making remarkable progress. Though still in the nursing home he recognizes people now. Those of you who know Ed, especially may want to get in touch with him.

When all this happened I put together the class notes for the August-September issue, and **Randy Binner** has taken the presidential step of looking for a class secretary to take over in the interim, since we don't know the future. **Wyman Boynton,** our lawyer classmate of Portsmouth, N.H., has agreed to take on the job. We all know Wyman, and his wife Mildred throughout many years of class activities. Louise and I called on them yesterday in their fine old home in Portsmouth where they have lived for many years. I believe Mildred said their 55th Anniversary is coming up. The address is listed at the end of this column so you can begin sending your items for the class notes directly to Wyman!

For all associated with the *Tech Review* there was an interesting assemblage in honor of John Mattill, longtime editor—now editor emeritus of the Review. It was held in the Lobdell dining room of the newly renovated and improved Stratton Student Center on campus, a fine place for some of the activities for our soon-to-come 60th reunion in June 1991!

Frank Dame in Florida sends his best wishes. . . . **John Hollywood,** I assume from New Jersey, mentions his amateur radio W1SK. . . . **Horace Ford** notes that his 80th birthday recently reminds him he was born the day before Peary discovered the North Pole.

Notice of recent awards to **Jack W. Lane** of Tuckahoe, N.Y. give record of his interesting career: Reserve Officers Training Corps in 1928, Franklin Motor Car Co. 1930-32, mechanical engineering instructor at MIT 1931-34; Socony-Vacuum, chief automotive engineer, New England, then transferred to N.Y. Corporate Headquarters 1939; Retirement in 1974, then consultant for C.R.D. Total France until 1987. He received the National Lubrication Grease Institute Spokesman Award and the ASTM Committee D2 Award of Appreciation.

John E. Spalding from Santa Rosa, Calif., writes he has remarried, to a California gal (Alice) in fall of '86 and moved "here a year later. Had both valves replaced a year ago but am now getting my three 18 holes each week."

We have to expect notices of this kind, too: **L. Kernick Snowden** (I called him Ken but maybe that was wrong) died in March at Seacoast Health Center, Hampton, N.H. He was a summer resident of Rye, N.H., for many years and retired there from Belmont, Mass., 16 years ago. He was regional sales manager for Westinghouse Elevator Co., and a 32nd degree Mason of Alleppo Temple Shrine in Boston. Survived by his wife Honora (Nelligan) Snowden of Rye, two sons, a daughter, and a granddaughter. Memorial donations may be made to Alzheimer's Disease Association, Chicago, Ill. 60601-5997.—**Edwin S. Worden,** Secretary, P.O. Box 1241, Mount Dora, FL 32757, (904) 383-3472; **Wyman P. Boynton,** Acting Secretary, 668 Middle St., Portsmouth, NH 03801, (603) 436-1309; **John R. Swanton,** Assistant Secretary, winter: 27 George St., Newton, MA 02158, (617) 332-8354; summer: RR2 Box 670, Wiscasset, ME 04578, (207) 882-7028

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The Technology Alumni Day in June was most interesting. The program on the space age convinced me that I knew very little about modern day scientific achievements. Our class was well-represented by the following members: **William Bannon, Wendall Bearce, Donald Brookfield, John Brown, Melvin Castleman, Albert Dietz, Francis Gowen, Harry Johnson, Douglas Miller, Charles Taylor, Thomas Weston,** and **Bill Pearse.** All attended a class meeting called by our president, **John Brown,** on Friday afternoon. All reports of last years activities were heard and approved. It was decided that a mini-reunion should be planned that might last from Thursday evening to Saturday afternoon. By tying in with other Technology Day programs and with the Cardinal and Grey Society, a very pleasant and congenial get-together can be planned at a reasonable cost. The class appointed **Don Brookfield, Tom Weston, and John Brown** as the committee. Past president, Prof. Albert Dietz of the Cardinal and Grey Society was appointed honorary consultant.

There was a memorial service for all alumni and alumnae who were reported deceased during the proceeding year. The following were from the class of 1932: **Sidney E. Caldwell, William S. Clark, Gardner Cox, John A. Finnerty, Jay H. Forrester, Edmund B. Fritz, George Goodman, Ray Hawksley, Richard Huessener, Waldo E. Laidlaw, Walter A. Lazar, James L MacKernan, Robert E. Moore, Morris M. Newman, Max Richmond, Herbert F. Ross, Robert B. Semple, Keith Smith Jr., Elmer H. Stotz,** and **Charles M. Thayer. John Brown** and Mrs. Dorothy **(John) Finnerty** attended the memorial service.

Tom Weston writes that he attended the "Ice Chips" production of the Boston Skating Club. **John Brown,** who has been a skating member for 35 years, was the oldest participant. . . . **James Smith** is retired, but he still does some consulting. He contributed much to fire protection and has received many patents in this field. He has celebrated his 30th wedding anniversary, and hopes to come to our next reunion.

Henry Duncan lost his wife seven years ago. He has three children and six grandchildren. He does some travelling and likes bridge and dancing. . . **Don Corson** of Leicester, N.C., is retired but still does a little consulting. He enjoys gardening.

We received word that **Willard "Will" Meyer,** 78, died at his residence on April 9, 1989. He was an industrial engineer for American Can Co. for 40 years until his retirement in Maine in 1973. He is survived by his wife, five children, and seven grandchildren.—**Melvin Castleman,** Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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First, we must sadly report the demise of classmate **Robert G. MacKay,** May 4, 1988, Stillwater, ME 04489. Mrs. MacKay may be reached as indicated.

The IEEE awarded the Medal of Honor to **C. Kumar N. Patel,** executive director of research in materials science, Engineering and Academic Affairs Division, AT&T Bell Laboratories, Murray Hill, N.J., for "fundamental contributions to quantum electronics, including the carbon dioxide

John Brown, '32, and partner Clara McCarty glide at the Ice Chips, the annual show of the Skating Club of Boston last April.

laser and the spin-flip Raman laser."

Small World Department: Mr. Patel was a protege of William H. Doherty, Ph.D., Harvard, one of my warmest friends here on Hilton Head.

The IEEE also awarded the Founders Medal to **Ivan A. Getting,** president emeritus of Aerospace Corporation, El Segundo, Calif., for "leadership of critical programs and enterprises in radar, advanced electronics, space and navigation as well as service to the engineering profession."

A gorgeous photo postcard from **Bill Huston** from Bled, Ygoslavia, mentions: "And this is only the first day." . . . **Walt Skees,** apparently a permanent resident of Apartado 627, Barcelona, 08080 Spain, proposes group reunions by five-year brackets to permit renewal of friendships of alumni who were on the campus contemporaneously. He included an interesting recommendation from the municipal laboratory of the Board of Health of Barcelona for his son, who "demonstrated a high level of preparation and dedication as well as fine sense of responsibility in all his work."

Dick Fossett reports the completion of their Antarctic trip on the ship *Illiria*. . . . I received a long and very interesting report from **Quimby Duntley,** 2570 Caminito Porthcawl, La Jolla, CA 92037. Most of his career was at Scrippps, La Jolla, first with the Navy then with the University of California at San Diego where he taught oceanography and applied physics among other things, particularly optics. He was president of the Optical Society of America, and did consulting committee work for the U.S. government. Now he is professor emeritus. His wife Mabel was a harpist for N.E. Conservatory of Music, and in a five-harp ensemble playing everywhere including Radio City Music Hall. They have a son doing classified work for the government, one daughter married to a physicist also working for the U.S. government. Dr. Duntley is re-translating the Bible for recreation, if you please, from the original writings which contain "no scientific nonsense" as contrasted with the translations used by all churches he knows of that contain considerable amount of scientific non-sense.

Your secretary concludes that many of our fellow alumni managed to get into or through MIT without learning how to write. If you will contact your secretary he will give you writing lessons over the telephone or by mail.—**William B. Klee,** Secretary, P.O. Box 7725, Hilton Head Island, SC 29938, (803) 785-7746

34

I must apologize for the lack of notes in the last few issues; the only news I was receiving was of deaths, and that seemed too depressing. However, now that there is a successful reunion to write about, I can face up to the distateful part of this work.

On January 3, 1989, **Bennett Fisher,** of Greenwich, Conn., died after a debilitating illness. His degree in ship operation at MIT came after a philosophy degree at Yale and a year at Trinity College in Cambridge, England. He started his career with the Grace Line as an engineering officer; after the war he went to Dorr-Oliver in Stamford and stayed there until his retirement in 1966. Mr. Fisher was active in town affairs and served as a member of the Greenwich Representative Town Meeting from 1957 until he retired from it in 1985. He was an active sailor all his life with memberships in the Indian Harbor Yacht Club, the Storm Trysail Club, and the Cruising Club of America. Mr. Fisher is survived by his widow Elsie, three sons, four daughters, two brothers, a sister, and six grandchildren.

We lost a faithful correspondent when **Jerome Raphael** died suddenly on April 3, 1989, in Lafayette, Calif. If you have followed this column you will recognize his name as an international authority on reinforced concrete structures, especially large hydro-electric projects throughout the world. As an off-shoot of this expertise he designed, built, and sailed his own reinforced concrete sailboat, and helped organize the concrete canoe team of the University of California at Berkeley. Professor Raphael joined the Berkeley faculty in 1953; he was a life member of the ASME and a fellow of the American Concrete Institute. In the course of his career he published over 100 research reports and technical papers. Raphael is survived by his wife Ruth, two sons, a daughter, and two grandchildren.

John Hitchcock died in Framingham, Mass., in May 1989. Following graduation in 1934, John joined Dennison Manufacturing Co. and served in a number of management positions until his retirement in 1976. He was active in town and party politics and was a Town Meeting member for many years; he also worked with civic organizations, including the United Fund, the Red Cross, and the American Cancer Society. John is survived by his wife Doris, a son, a daughter, and three grandchildren. He and Doris faithfully attended most of our reunions.

There are four other losses that I can only report, as I have no information about the men involved: **Donald McQuillan** died in Suffield, Conn., on December 20, 1988; **Edwin Williams** in Mississauga, Ontario, on May 31, 1988; **Harold Adams** in Indianapolis, Ind., on January 10, 1989; and **Wolfgang Rahles** in Worthington, Ohio.

In last year's November-December issue, I reported the death of **Frederick Parks.** Since then I have word from our treasurer, **Larry Stein,** that Mr. Parks left a sizable bequest to the Institute, sent to Larry by Mr. Parks's daughter. He passed it on to the Institute, where it was credited to our class gift. It is always pleasant to acknowledge the thoughtfulness and generosity of classmates who make gifts of this nature.

Now, the story of our sucessful reunion. We had a good turnout in Chatham—46 class members and 44 wives. As one might expect on the Cape, the weather included a fair bit of cloud, haze, and fog, but no real rain, so it didn't interfere with people's fun.

An effort was sparked by **Hank Backenstoss** and some Course XVI classmates to bring **Wing Fong Wu** to the reunion from Beijing, China. I have written from time to time about him and how we have kept in touch by visits of classmates on tours of China. The response to Hank's committee was excellent, and enough money was raised for the trip, but the planning turned into something out of a soap opera. When Wing applied through his institute for a passport, the rule was that, because he is over 70 and a retired professor, he had to be accompanied by a physician or some younger person. This could have been avoided if he had applied directly as an individual, but that would've meant going back to square one. In the meantime the committee here had been working on his American visa, which was waiting at the U.S. Embassy in Beijing when the passport came through. This process was further complicated by the demonstrations that were developing in China. Wing did finally make it, we all enjoyed seeing him, and he seemed to enjoy himself greatly. One evening, after dinner, he talked to us for more than an hour about his life in China, what he had to put up with during the Cultural Revolution, and what he has done in his working and teaching career. While there was a lot of interest in the immediate situation (the shooting in Tianamen Square had already begun), Wing naturally had to be somewhat circumspect in his comments. He felt that the day-to-day news reports could not be taken completely at face value. On the evening we spoke, we presented him a red MIT 50-year jacket to take home.

When **Carl Wilson** got to Chatham, he had notes from some of the usually faithful attendees of past reunions who had to pass up this one. These included **Sam Groves, Jerry Minter,** Rosemarie and **Ted Kresser,** Ellie and **Phil Kron,** and **Fran "Doc" Doyle.** Doc was one of the group that worked on bringing Wing over; fortunately, Doc lives in Pottsville, Pa., not too far from **Hank Backenstoss** in Reading—and Hank was taking Wing home with him from Cambridge. The Chatham reunion moved to Cambridge on Thursday, June 8, for Pops Night and the following Technology Day events. A good number of those in Chatham went along, and some 16 others, most with their wives, joined in. A pleasant part of this day was the presence of four widows of former classmates, as guests of the class. Since this was one of our five-year reunions, one action taken in Chatham was the election of class officers for the next five years. Happily, all the present officers were able and willing to continue serving, so they were re-elected.—**Robert M. Franklin,** Secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull,** Assistant Secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

35 55th Reunion

With less than a year to go to our 55th reunion, lots of related activity is taking place. **Hal Bemis** is chairman of the Nominating Committee, with **Randy Antonsen** and myself. Hal will be looking for additional help and suggestions for officers. . . . **Bernie Nelson** was recovering from a quintuple bypass surgery at Mass. General as of May 12, and plans to retire after our class meeting next June. . . . **Goffe Benson** is reunion chairman, with **John Taplin** in charge of the MIT portion and **Dick Jarrell** as his assistant. Bernie will be planning the Cape section with the help of **Leo Dee.** By the time you read this you will have received Bernie's letter with more details. Plan now to hold June 6-10, 1990, open to attend.

I have a brief note through the Alumni Office from **Oscar F. Wiedeman,** who retired in 1983, lost his wife in 1986, and is currently in poor health with limited moibility. His mailing address is 125 Levee View Dr., River Ridge, LA, 70123. . . . Hal Bemis passed along word that **Charles Debes** had a massive stroke on March 9, 1988, but is hopeful that in another year he will be able to walk around.

The secretary for the class of 1933 called me recently to report the death of our classmate **Tho-**

mas C. Keeling on June 16 in Savannah, Ga. He was a member of Sigma Chi and Course X. He served in World War II and retired as lieutenant colonel in the Coast Guard Artillery. He was with Koppers in Pittsburgh for 45 years, retiring in 1977 as executive vice-president and director. He is survived by his wife Jessie A., two children, a brother, and three grandchildren. I am sending his wife our expression of condolence at their home, 58 N. Calibogue Cay, Hilton Head, SC 29928.

I had a most enjoyable trip back East to give my youngest daughter in marriage on June 3 in Springfield, Mass. It was a fine opportunity to be with the entire eastern half of my family, including four children, four happy spouses, 11 granddaughters (I have three more in Washington state), and my sister Annette and niece Sally, who flew from Minnesota to drive her mother down from Sandwich, N.H. It was sunny for the wedding and a golfing day, but rained the rest of the time. Got back here on the 8th to continue square-dance lessons—now in Mainstream. Great for exercise and making friends! By about now you should be able to drop me a card or note and tell me how you are doing.—**Allan Q. Mowatt,** Secretary, 715 N. Broadway, Apt. #257, Escondido, CA 92025

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Second installment of a trip through the northeast, which omitted Boston-Cambridge and its environs: Heading north in the Connecticut River valley, I stopped in East Longmeadow, Mass., to see **Wendell Fitch,** Course X-B, whose father and **Alice Hunter Kimball**'s were classmates in '02. Initially, Wendell was in research and development for Goodrich, worked on the design of the pilot plant for synthetic rubber and ran the first full scale commercial production. Subsequently he was with Monsanto, Chicopee, and Bigelow-Sanford where he modernized the scouring of fibers. But he and wife Trudy and two daughters found a family interest in roller skating, amateur and professional. So while Wen pursued a construction and real estate business, Trudy designed skating costumes. They now have a mail order business for patterns, with customers in all 50 states, Australia and Canada. Orders come also, at times, from other countries as American skaters on tour wear Fitch designs. Wen keeps young and in touch by judging skating competitions. He recalls friendships with **Charlie Holman, "Gus" Chandler, Frank Parker,** and **Ed Rowe** in undergraduate days.

After an overnight stay in my former hometown of Brownsville, Vt., I had mid-morning coffee and muffins with **Walt MacAdam** and Rilla in Hanover, N.H. Walt has kept busy consulting on incinerators, among other things, including one for the City of Claremont to burn all its trash, and one for the new Dartmouth-Hitchcock Medical Center. Walt expressed in a few words what other classmate consultants have surely felt: "Individually and collectively we have a wealth of experience, in many fields, which can be of use to mankind. Even though retired, we may have opportunities to apply our expertise to save time and money on projects undertaken in our communities."

Down route I-89 to lunch with **Fletch Thornton** and Peg in New London, N.H. They were just back from golf in the rain at Southern Pines, N.C., which also treated them to sleet and ice in that odd winter. Fletch has recovered from a carotid operation, has better coordination, and can hit the ball. Their daughter Barbara in Cologne, Germany, and another *American* and a *Dutch* woman were chosen by the German government to tour Europe, India, and other places as a three voice ensemble to spread *German* culture. Fletch and I were classmates from sophomore year in high school, and we reminisced on the great teachers we had and the tough college board exams.

Bill Healy (Course VII) in Concord, N.H., could not meet with me, but over the telephone mentioned that he hears regularly from **Al Bagnulo** at Alexandria, Va. Bill was for many years a director of New Hampshire's water supply and then ran its pollution control commission until 1988. He is one of several classmates working on the Institute's Campaign For The Future.

Across lower Maine to Westbrook and the home of **Towers Doggett** and wife Doris. They set me up with dinner, bed, breakfast and much newsy conversation. He was manager of hockey in junior year and recalled **Ed Rowe, Wen Fitch, Len Chandler, Frank Parker** and **Bill Healy** active in the sport. Doris hails from England, and the two have made several trips back since Towers retired. Their favorite mode of travel over there is on a rented canal boat, powered by a small diesel to make four knots. "It's like having a camper on water, with canal-side pubs along the way for lunch and dinner." Towers has been active in the MIT Club of Southern Maine, and has been in touch with classmates from Portland to Bath and beyond.

He and Doris drove to see **Willard Greenwood** (Course IX-A) and Nancy in Scarborough. "Bill" entered our class in junior year from Worcester Poly. Both couples are deep in sailboating on the Maine coast, and know what it was like, before LORAN, to be deep in fog groping for the next buoy with only bells and horns as guides. Their organization title "Maine Coast Cruising, Boozing and Snoozing Society" underplays the activity.

After graduation Bill used the chemistry part of IX-A assisting Professor Hardy in his consulting work on photomicrography and in writing a book on colorimetry. After the war, Bill ran a spectral photometer in Hardy's lab at night, after his daytime stint with Forbes Lithograph, where he rose to be vice-president of manufacturing. Later he did research for Scott Paper. He has skied since the age of six.

Paul Richardson (Course II) in Yarmouth, Maine, was not at home, but wife Virginia recalled the Phi Delta Theta house dances and numerous Institute affairs while dating Paul. Just before graduation they were planning to meet **Francis Peterson** and Winnie at the Class Tea Dance in Walker Memorial, but became intrigued with dinghy sailing on the Charles, recently begun under the leadership of **Bob Gillette,** first commodore. Result: Paul found a willing skipper; Virginia shucked off hat and heels, and away they went on the Basin—"better than dancing on that hard terrazzo floor." Paul was still working in 1986 and could not make the 50th reunion.

Philip Grant (Course XV) in North Windham also was not at home, but I saw his son Hamilton and daughter-in-law living nearby. They informed me that Phil's wife Lillian died of cancer last year, and that Phil himself was at the doctor's for treatment. I reached him by telephone after my return to New Jersey, and he expressed some embarrassment at being included in the class because he had to leave in sophomore year—another Depression casualty. I assured him that, in my own experience of friends having to drop out, he was one of a considerable number who nevertheless continued their interest in the Institute—no reason not to be listed as a class member. Phil did well in insurance company administration, retiring at age 62 as senior vice-president of Union Mutual Life.

Douglas Woodward had an even shorter term with us, as a graduate student in a special program of Course VII sponsored by the federal government. He was University of New Hampshire, '34, (see 50th reunion biographies) and working for the state Public Health Department on sanitation engineering, when he was selected to join a group of 40 engineers, doctors, nurses and sanitarians for a pioneering study of ways to improve public health. In the war he was Lt. Colonel, Corps of Engineers in the Southwest Pacific. He then spent 32 years with the U.S. Geological Survey, during which he wrote several articles on archeology and water supply, and won the Distinguished Service Medal of the Department of the Interior. Doug lost his wife Geraldine in 1984, and about the time of our 50th reunion he married Beverly Powell, widow of Governor Wesley Powell of New Hampshire. They are a lovely couple who took me into their home at Hampton Falls as they would an old friend. I hope they come to our 55th. He has an almost professional woodworking shop in one of their outbuildings, and his grandchildren call him "Mr. Woodworks." . . . **Harold Brown** (Course XIV Electrochemical) is retired from Avco Research. He has had kidney dialysis treatment at his home in Hampton over a period of years, and when I telephoned, he was at the hospital for conversion to a new system. Dialysis takes several hours and requires a constant attendant. The new system is much less demanding, and he and wife Muriel look forward to greater ease and convenience. Best wishes to you both from the Class!

Harold and **Ken Swain** (Course II) of North Hampton are cousins, and at MIT lived in a Back Bay apartment within sight of Fenway Park. They didn't have much time for games, but they could mingle with Red Sox players as they got 25-cent haircuts in the barber shop under the stands. Ken recalled that during a severe winter in the 30s, **Art Wells** took a shortcut across the icebound Charles from Walker Memorial, under the Harvard Bridge, to the Phi Sig house on Beacon Street. Art took his time coming out from under the bridge, and Ken, waiting overhead, had some anxious moments. Ken is retired from Chase-Shawmut Corp. Earlier he was vice-president engineering at Gould, Inc., and he has a number of patents on his inventions.

On April 22 your class officers met at the Farmington, Conn., home of **Eli Grossman** and Vivienne, who served us a delicious Passover breakfast. **Ed Dashefsky** was unable to come, but with **Pat Patterson** and myself, **Alice Kimball** had a quorum. She reviewed the discussion at Pasadena last October (see May-June Notes), and there was much interest in encouraging attendance at the 55th reunion by classmates who did not make the 50th. Please note the date: June 6, 1991, is Alumni Day, when our class has an honored position at the luncheon, and events before and after will make it a worthwhile excursion. The mini-reunion at Alice's this October 28 will be an opportunity to put forth ideas.

On my trip to lower New Jersey and eastern Pennsylvania, recounted last issue, I had hoped to see **Dick Denton** in Marlton N.J., but I learned from his business (now operated by his son Peter, '67) that he and Virginia were touring the Orient. A letter on his return tells of taking home video shots at the Great Wall, etc. He now finds some pretty good tape "along with the shots of the sky and our feet—I may spend the rest of my life editing the stuff!" Dick's letter also mentioned **Chuck Kennedy** and the basketball team, so I sent him a copy of two pictures clipped from *The Tech* and a 1934 Boston paper. **Bill Garth, Fletch Thornton** and Chuck are shown with senior members of the team and Coach "P.T." McCarthy.

Alice reports better-than-average (for an off year) attendance at the Alumni Day lunch June 9: **Bob Caldwell** and Sarah, **Larry Peterson** and Lillian, **Dorian Shainin** and Margaret, **Bob Walker** and Thelma, **George Parkhurst** and Barbie, **Ed Dashefsky** and Rose, and **Ben Cooperstein**'s widow Florence. Also, **Bill Metten** and **Elmer Davis** were at the Pops.

Cheers and a toast to the life of **Jack Chapper,** who died April 21 of cancer. He and Rosalie had been with family in Sarasota since last September, and he went to a clinic in Tampa when taken ill. **Ed Dashefsky** and Rose attended the funeral. They were close friends as well as classmates. For about 40 years Jack produced HO model train kits and did business with the trade name "Hobbytown of Boston." The quality of his product is exemplified by a customer's recent comment to Rosalie: "The train we bought 30 years ago is still in perfect working order." In earlier years Jack was active in tennis and flying, holding a private

pilot's license. He and Rosalie took a wedding anniversary trip to the Orient, a gift from their children, just before attending our 50th reunion. She is at 44 Linden Ave., Swamscott, MA 01907.

Jim Ullman's death last October, reported in previous Notes, came shortly after celebrating 50 years of happy marriage to Sylvia. He was semi-retired from 48 successful years of real estate development and management, and had been Governor of the Cleveland Real Estate Board and a member of Hebrew Free Loan Board. Sylvia has two sons and four grandchildren to comfort her, and she continues living at 2425 North Park, Cleveland Heights, OH 44105.—**Frank Phillips,** Secretary, 901 Los Lovatos, Santa Fe, NM 87501, (505) 988-2745; **James Patterson,** Assistant Secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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The Technology Day Luncheon was attended by **Winthrop Comley, Edwin L. Hobson,** Pearl and **Lester Klashman, Melvin Prohl,** Genevieve and **Leonard Seder, Roger W. Winthrop,** and **Roger W. Wingate.** Pops the previous evening was attended by Jane and Winthrop Comely, Edwin L. Hobson, Jan and Melvin Prohl, Rose and **Robert Thorson,** Skipper and Roger W. Wingate, Louise and **William Wold.** Everyone seemed to be getting along satisfactorily considering our age. Ed Hobson's youngest daughter, of 11 children, is still completing her education.

Winthrop D. Comely, P.O. Box 219, 117 Drinkwater Rd., Hampton Falls, NH 03844, retired as a consultant for Stone & Webster Engineering Corp. in Boston in December 1984. He writes, "Worked for a while after retirement—part time at Stone & Webster, then part time for the office of governor of New Hampshire on evacuation plans for Seabrook nuclear plant. Am now secretary and member of executive committee for New Hampshire Southeast Regional Refuse Disposal District. Have six acres of land to take care of, including 100 apple trees (with no apples this year) plus small garden. Have taken up golf again after 20-year lapse. Score is no better. Recently took a Bermuda cruise. Attended Alumni Day, and was sorry that more of the class did not attend. Now that Cardinal and Gray Society has been established, hope more will come next year. (See Class of '28 notes.—*Ed.*)

Jerome E. Salny, P.O. Box 304, Fairlawn, NJ 07410, writes: "As I get older, it gets harder to answer the question, 'What's new?' Abbie and I do keep busy, and life goes on, but with less pressure. Abbie's eighth book, *The Mensa Quiz-a-Day Book,* has been sent to the publisher and will be in the bookstores in early September. As for me, I have kept one tiny manufacturing business (subcontracting out the production), and I have to get up and go to the office every morning. On the other hand, I have it set up so that we can travel a great deal. Last month we were at our apartment in Paris and took off to spend a week on a canal boat on the Canal Laterale de La Loire in Burgundy. We run it ourselves, and *I'm the Captain!* (Can't get lost!) Abbie cooks when we don't stop at a local restaurant, and Toby (a long-time friend) washes the dishes. The two of them handle the lines at the many locks. A feature of this trip is the Point de Canal at Briare. At this charming town, the Canal Laterale connects with the Canal de Briare. Unfortunately, they are on different sides of the Loire River, which is some 200 feet below. Alexandre Gustave Eiffel (the tower man) made a bridge to connect the two canals. It is quite a thrill steering the boat along the narrow bridge and looking over the edge into the tops of the trees below. (We find this do-it-yourself boating much more fun than the luxury everything-done-for-you barges.) We're going back to Paris for the 200th anniversary of Bastille Day July 14. So, it's still full steam ahead, as long as the engines hold out!"

Virginius N. Vaughan, Jr., 69 Elmwood Ave., Chatham, NJ 07928, retired in 1980 as director of Data Communications Standards at AT&T. He currently is a self-employed consultant to the Department of State (Telecommunications Office). Wife Sally's main interest is art. Virg writes, "Recent travels to the bank, store, and home. I am still an independent consultant."

I regret that **Charles G. Hammann,** 247 Blackstone St., Woonsocket, RI 02895, died of a heart attack June 15, 1963. He is survived by his wife Margaret, two sons, and two daughters. . . . **Matthew L. Rockwell,** 393 Fairview Ave., Winnetka, IL 60093, passed away at home December 7, 1988. "He was a very creative thinker as an architect and as a planner," said his daughter Ellen Galland, also an architect. "He was particularly proud of the Armature Plan that he authored through the Northeastern Illinois Planning Commission in the last 1960s." The plan focused on the principal shaping developments of the region, particularly the commuter railroads along which development would occur. It was called the Armature Plan because the approach was similar to one used by sculptors in which the artist first sets up an armature, or skeleton, for the work. It represented a new concept in planning at the time. His great-grandfather, Matthew Laflin, arrived in Chicago in the 1830s with a load of blasting power to help dig the Illinois and Michigan Canal. In the 1840s he became a director of the Hydraulic Co., which supplied the city's water. He donated the funds to build the Chicago Academy of Sciences building at 2001 North Clark Street. During World War II, Matthew Rockwell was director of planning for the U.S. Army Corps of Engineers in the Chicago area and was responsible for the site selection and design of the airfield that is now O'Hare International Airport. From 1946 to 1961, he was a partner in Stanton and Rockwell, Architects and Planners, Chicago. From 1961 to 1963, he was director of public affairs and urban programs for the American Institute of Architects in Washington, D.C. He then became executive director of the Northeastern Illinois Planning Commission until 1979. During that time, its staff grew to 130 from 19 and its budget to $6.3 million from $200,000. In recent years, he had been a visiting lecturer and had been associated with his daughter's architectural firm, Rockwell Associates, In Evanston, Ill. Survivors, beside his daughter, include his wife Molly, daughter Joan Eyster, five grandchildren, two brothers, and a sister.—**Lester M. Klashman,** Secretary, 289 Elm St., Apt. 71, Medford, MA 02155

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Following Technology Day, 33 of us enjoyed another mini-reunion at MIT's Endicott House. Present were: Florence and **Sid Baron,** Hilda and **Norm Bedford,** Sandy and **Lou Bruneau,** Madelyn and **Paul Des Jardins,** E and **Frank Gardner,** Roberta and **Horace Homer,** Alice and **Roy Hopgood,** Pat and **Bob Johnson,** Ruth and **Frank Kemp, Fred Kolb,** Ruth and **Paul Lappin, Norm Leventhal,** Nancy and **Y.T. Li, Dave Morse,** Marie and **Paul O'Connell, Jack Phillips, Harry Saunders,** and Phyl and **Don Severance.**

Cards were signed by all to four other couples who had registered but had to cancel: the **Ed Trues, Paul Blacks, Haskell Gordons,** and the **Dick Hendersons.** Haskell arrived home on Father's Day, following surgery and two weeks in the hospital. Dick is fine after some surgery that, as a biologist, he can explain better than I can understand. . . . Now, how about some news from you—yes, you!

Unfortunately, the only news I have left this month is neither rewarding to write nor enjoyable to read, namely, word of the passing of five classmates. I recently enjoyed a long telephone call with Ruth and **Paul Black,** but I now must sadly report that Phyl and I have just returned from Paul's funeral service in Sudbury where they lived before moving last year to Damariscotta, Maine. It's painful to report the loss of a classmate, but doubly so in this instance for Paul was my closest friend in the class from the day we met as freshmen. Paul was as active in class affairs as 15 moves and business travel permitted. He was chairman of our 35th reunion, wrote the section "Do You Remember?" for our 25th reunion book and "A Flashback" for our recent 50th reunion book.

Paul was one of the first to graduate in illuminating engineering, Course VI-B. In World War II, he served on General Bradley's First Army staff during the Normandy invasion and subsequent European Campaign and was responsible for establishing the radio network for the First Army for the D-Day invasion. He earned the rank of captain and was decorated with the Bronze Star. In 1939, he joined Sylvania—later GTE-Sylvania—with whom he spent 41 of his 43 career years. Starting as a research engineer in the Central Research Labs, he became program manager for the Air Force project that was the company's largest military contract. Later he was responsible for integrating the marketing efforts of the operations of this division that developed and manufactured electronic equipment for DOD and NASA. During his last 17 years at GTE, he was director of long range planning for the company's Government Systems subsidiary. In retirement, he continued his lifelong involvement with the Catholic Church, especially working with a lay organazation dedicated to helping others, from teenagers to retirees, to understand their faith.

Nick Barbarossa died last September in Williamsburg, Va., where he had lived and served as a consultant on water resources for James River County the past 11 years. Nick retired in 1975 from the Army Reserve Corps, having served with the Corps of Engineers, the Missouri River Basin Commission, and also for the State of New York as director of water resources planning. He also served on the U.S. Commission on Large Dams.

John Burke passed away last February. Following an SB degree from MIT, he earned master's and doctorate degrees from Stanford. He was a B-17 pilot during World War II for which he received the Oak Leaf Cluster. John taught history of science and technology and was the author or editor of nine books in that field. An emeritus professor of history at UCLA, he was Dean of the College of Letters and Science from 1974 to 1977.

Fran Buffington, who received SB and ScD degrees from MIT died in April at his home in Flintridge, Calif. He was appointed assistant professor of mechanical engineering in 1951, immediately after his MIT doctorate, and associate professor in 1956. Seven years later he changed his field to materials science for which he was named full professor in 1983. He conducted research in the diffusion of solids and phase transformations in solids. He served on several of Cal Tech's faculty committees. The bulk of his service was as associate dean of graduate studies, chairman of the graduate admissions committee to monitor first-year PhD students in those fields.

Lastly, **Gerson Hermann,** who graduated in chemistry, died seven years ago—a fact that **Ed Hadley** uncovered during an MIT telethon a year ago. Unfortunately, the only information we have is that he last was chemist for the Apex Chemical Co. of Elizabeth, N.J. Can any of his chemistry or New Jersey classmates provide more information?

That's all there is until you send more news.—**Don Severance,** Secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley,** Assistant Secretary, 50 Spofford Rd., Boxford, MA 01921

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Jim Barton, chairman of our 50th reunion gift committee, announced at the Technology Day Lunch our class gift of $5,611,000. Gifts were made by 82.7 percent of our class, a new MIT record for participation. This money will establish a $1 million James Ferry Engineering School Fund, add $389,000 to the 1939 Scholarship Fund

bringing it to $558,000, establish the Materials Science and Engineering Fund, and establish the Richard Feynman Scholarship Fund in honor of our deceased classmate and Nobel Prize winner. In addition to the 50th reunion gift, members of our class designated MIT as beneficiary in their wills for $1,159,000.

The Reunion Gift Committee included **James Barton** (chairman), **Harold Muckley** (honorary chairman), **Peter Bernays, William Brewster, Philip Bush,** Mrs. **Robert C. Casselman, Harold Chestnut, George Cremer, King Cummings, Richard Donohoe, Fred Grant, Michael Herasimchuk, John Herlihy, Harold Hindman, Burkhart Kleinhofer, James Laubach, Richard Leghorn, Leonard Mautner, Charles Mercer, Manning Morrill, George Morrison, William Murphy, Morris Nicholson, Lawrence Perkins, Irving Peskoe, Fred Schaller, Harold Seykota, Paul Stanton, Oswald Stewart,** and **Theodore Wroblewski.**

Leading our class and carrying the '39 banner in this year's commencement procession were **Peter Bernays, William Brewster, William Cutten,** and **Charles Wang.** (See *Technology Review,* August/September, p. MIT 8.) Twenty-four other '39ers joined the procession.

William Cutten's father, Leverett H. Cutten, '07, an expert silversmith, designed and made a mace (a symbol of authority traditionally carried before a public official or legislative body) for MIT. This mace has been borne by MIT's Alumni Association president at commencement for many years.

About 126 classmates and 106 spouses and guests attended reunion activities. The following were re-elected class officers for term of five years: President Seymour Sheinkopf, Vice President Oswald Stewart, Vice President Aaron White, Treasurer Joseph Dana, Class Agent Ernest Kaswell, Secretary Harold Seykota, Estate Secretary Manning Morrill.

Songfests started Monday at Chatham and increased daily in enthusiasm and volume until the last B-flat seventh was reached for on Friday night at McCormick. **Morrie Nicholson** directed and was helped by **Win Reed**'s immense repertoire. Songfest superstars included **Fred Cooke** at the piano and Eugenia Cooke perched on top of the piano doing her version of "The Persian Kitten." Outstanding harmonies were heard from Nancy Smith's lead, **Nick Carr**'s tenor, and **John Alexander**'s deep bass. **Aaron White, Morrie, John Alexander,** and **Hal Seykota** did the songsheets and planning.

Aaron outdid himself again when he arranged top-notch musicians for two nights of dancing at Chatham. Our special thanks to **Aaron,** Billy Novick on clarinet and vocals, and Guy Van Duser on acoustic guitar. Both of these pros interrupted their performing with the world-famous New Black Eagle Jazz Band to do our dates. A filled dance floor evidenced '39ers approval of the tunes and tempos.

Vahey Kupelian died December 9, 1988, and details were not available. However, just before Tech Night at the Pops this year, **Oz Stewart** and I were privileged to visit with Louise Kupelian who showed us the program for "Retirement Banquet of Mr. Vahey S. Kupelian, Engineer and Patriot." The banquet was at the Fort McNair Officers' Club, Washington, D.C., and the program listed his achievements and honors during 39 years' service with the Department of Defense. He received the following awards: Department of Defense Meritorious Civilian Service Award, Army Decoration for Exceptional Civilian Service, and the AIAA Missile Systems Award, 1984. Louise, we appreciate your sharing this memento, and we take pride in our association with you both. By the way, do you continue playing super piano in jazz style?

George Cremer telegraphed his greetings to classmates and **Dodie Casselman** on June 6. I read George's cable to tablemates at Chatham. During lunch Friday at the MIT Athletic Center, a card for classmates' signatures was circulated and mailed by **Manning Morrill** to George. Ten days later, Hilda and I were in San Diego visiting Ge-

Excellence in His Town and around MIT

"I'm not going to rust," Jim Barton, '39, told newspaper columnist Bob Welch on the occasion of retiring as mayor of Hunts Point, Wash., in August 1988. In truth he shone brightly. His next goal was to raise $3.9 million as chairman of his MIT 50th reunion gift committee, and like many endeavors in his life, this was greatly surpassed. (See 1939 class notes reunion report.) Excerpts from the Bellevue, Wash., Journal American *tell a lot about the character that contributes to Barton's success:*

In 1977, Hunts Point Mayor Jim Barton figured it was time to step aside. He'd been mayor for nine years. It was someone else's turn.

But the transition took a bit longer than expected—11 years, to be exact. . . . What happened back in '77 was that nobody else wanted Barton's job. Let's face it, being mayor of a residential town of 550 people isn't exactly filled with prestige and perks. For Barton, it basically meant council meetings in his living room, before the Town Hall was built in 1978.

Hunts Point isn't your typical problem-laden place. This is a place where council candidates have won on the strength of their stance on milfoil [a water plant]. . . . Per capita income is $49,380, making it the wealthiest community in the state.

But against such a backdrop is the reality that communities—regardless of their makeup—don't just naturally retain their quality. People preserve that quality. And Jim Barton, people say, has been a guardian of this forested finger of land surrounded by Lake Washington.

Reared in New Hampshire and schooled at MIT, Barton came west in 1939 as an industrial engineer with Boeing. [He retired in 1984 as general manager of Boeing International Corp.] Seattle residents at first, he and his wife, Mary, saw Hunts Point in 1944. It was love at first sight.

"The Point has changed," Barton says. "Once, it was a place where people came to find privacy, enjoy the lake, and raise a family. Now there's an increasing percent who come for the prestige, the status. They appear to be less concerned about the trees and the open environment."

Barton got involved in the town's political scene almost accidentally. In 1958, three years after Hunts Point had incorporated, residents pushed to cut their ties with the King County Library System. Barton fought against the tide. His side won—and he wound up on the Town Council. He became mayor in 1968 and was re-elected five times—without having to campaign once.

"He's been a good peacemaker, a good arbitrator," says Al Jepson, a neighbor and former Planning Commission chairman. "He's low key and doesn't lose his temper." . . . Throughout his tenure, say those who know him, Barton has been a quiet leader, methodical in his approach. Content, not charisma, matters to the man. So does preciseness. His 1966 Mercedes does *not* have 200,000 miles on it, he points out, it has 198,000.

His biggest personal battle has been dealing with multiple sclerosis, which he contracted in the mid-'60s. Among other things, the disease has forced him to walk with two canes. Given that—and given the time the non-paying job takes—you wonder why Barton didn't give up his mayoral post long ago.

He says it has to do with his upbringing. His father was a state senator in New Hampshire; Barton grew up believing that public service was simply expected. His daughter says it also has something to do with his subtle New England sense of humor, his ability to persevere with a pun here and a joke there. □

orge who had been touched by the thoughtful card and its many signatures, and he asked me to relay his thanks to all.

Dave Lindberg is retired after 36 years with Pacific Bell Telephone Co. He also tutored college level math and physics at American River College, installed lifeline telephone equipment in 18 hospitals, and is now active in Sacramento-area juvenile and church work and swims a thousand yards three times a week.

Meredith Wardle writes from Nome, Alaska: "Enjoyed 3.5 years sailing my own design cruising 28-footer—Seattle to Alaska twice, up and down the East Coast with a winter in the Bahamas. Got my second moose this year. Nailed him at 300 yards."

Aaron White relayed that the *Boston Globe* reported a memorial service last May 13 at Hingham for Stuart V. Arnold. Stuart's career included work at MIT on research projects for the Atomic Energy Commission and in metallurgy of steel, beryllium, and titanium at Watertown Arsenal.

Pete Bernays reports newsbits about '39er chemists. **Esther Garber** was nominated for election to the office of councilor in the Northeastern Section of American Chemical Society. . . . **Larry Woolaver** turned from Chemistry to physics, and his most recent assignments dealt with using optics in nuclear blast evaluation. . . . **Bill Postman** earned his PhD and taught at Georgia Tech for eight years. Later he worked for a Dow Chemical Co., which became Dow-Badische. He worked at Williamsburg and Anderson, S.C. Bill died in Anderson during September 1988. . . . **Harold Goodheim** made his career in machinery sales and engineering for the Department of Defense. He retired in 1982 and lives in San Diego.

Five out of six 39ers from Phi Beta Delta attended our 50th reunion. **Morrie Nicholson** reports attendance of six out of seven from Theta Delta Chi. Due to confusion about the ambiguity and/or misinterpretation of formula to be used by judges, there is some lay opinion that each of those 11 attendees received one bottle of Manning Morrill's prize champagne. And a good time was had by all.

Course V was represented by 10 '39ers at the reunion. **Mel Falkov** traveled farthest, from Cairo, Egypt, where he is on two-year assignment as regional director for International Executive Service Corp. Second prize for distance went to **Mark Curgan** and Lenore who came from retirement in South Carolina. **Pete Bernays** and Marie were third.

Eddie Rittner writes: "After three years at MIT in the electrical engineering department, I worked 23 years at Philips Lab, 15 years at Comsat Labs, and now live in the Washington, D.C., area."

Mike Herasimchuk and **Morrie Nicholson** send news items via their "MIT 1939 Course III/XIX Affinity Group Sporadic Newsletter: **Art Zeldin's** career in the Rocky Mountain states included developing processes for continuous casting copper shapes, researching use of oxygen to smelt copper concentrates, designing and constructing plants for precious metals refining. Art was associated with the world's largest magnesium plant in Henderson, Nevada. Early on, Art worked a gold mine in southern California upgrading ore and recovering gold bullion. . . . **Bob Schmucker** worked on permanent magnet castings. He helped develop Alnico 9, a high-titanium directional-grained material. . . . **Zeke Losco** took on a Westinghouse Doctoral Fellowship at Carnegie in 1939, transferred to Aberdeen Proving Grounds for five years, then rejoined Westinghouse Research. He, too, worked on titanium, developing gas turbine compressor wheels, also used in military planes. When Westinghouse switched to power rectifiers using germanium and silicon, Zeke was there. When Westinghouse took on the first USA nuclear reactor project for the Nautilus submarine, Zeke was there. When Westinghouse took on the first USA power reactor at Shippensburg, Pa., Zeke was there. At the same moment, I (Mike H.) was at Bethleham Steel helping make a low Ni-Cr-Mo forging to become the containment vessel at the same installation. Small World!"

Due to extraordinary efforts by **Mike Herasimchuk** and **Morrie Nicholson,** their Affinity Group made contributions totaling about $70,000 within the class total of $5,611 million.

The success of our 50th Reunion is due to lots of hard work—well-executed—by the reunion committee. The committee includes co-chairmen: **George Beesley** and **Bill Wingard.** Treasurer is **Joe Dana.** Committee members include **Bill Brewster, Dodie Casselman, Fred Grant, Ernie Kaswell, Dick Leghorn, Burns Magruder, Manning Morrill, Bob Pratt, Fred Schaller, Hal Seykota, Seymour Sheinkopf** (class president) **Sid Silber, Paul Stanton, Oz Stewart,** and **Aaron White.** They were helped cheerfully and promptly by staff members of the Alumni Association.

Wouldn't it be ever-so-thoughtful for about 100 '39ers to phone or drop a note to one or more of the above!—**Hal Seykota,** Secretary, 1701 Weatherswood Drive NW, Gig Harbor, WA 98335

40 50th Reunion

Plans for the great 50th reunion are getting under way. There have been two recent meetings of some of the committee members. On Alumni Day, June 9, I joined **Dick Babish, Jim Baird, Ed Bernard, Jack Danforth,** and **Walter Helmreich** at breakfast to begin the planning process, and we introduced Dick, as committee chairman, to the intricacies of scheduling a class reunion. On June 26, we met once more at the Alumni Office at MIT with Eliza Dame, the coordinator of reunions. Present were **Dick Babish, Jim Baird,** Sally Bittenbender, and I. By the time you read this column, you probably will have received the first mailing outlining the general plan. Briefly, it will be as follows: those of us who wish to will march in the commencement procession and stay for the exercises on Monday morning, June 4, 1990. We will then proceed to Mystic, Conn., where our program will be at the Mystic Hilton. A list of other facilities will be available for those who may prefer a "bed and breakfast" or a smaller motel. At Mystic, we will have class banquets and our class meeting. On Thursday, June 7, we will return to Cambridge, where we will attend the president's reception at 5:00 PM. Then we will take the bus to Symphony Hall for dinner in the Cohen Annex, followed by the Pops concert. Friday is Alumni Day, with the morning lecture series, and then the Alumni Luncheon, at which time class gifts will be announced. For those who stay in the dormitory (McCormack Hall), you may stay on through Sunday if you wish.

I have received a status report on the 50th reunion class gift as of May 15, 1989. The total gift stands at $2,651,000, a little over halfway to our goal of $4.5 million. Out of 406 classmates, 286 have made at least one gift to MIT for a participation rate of 70.4%. The median gift for our class over the crediting period is $250. In the current fiscal year only, the median gift is $100. We are doing well so far, but let's get that participation rate all the way up to the top!

A note from **Marshall D. McCuen** of Indianapolis says, "Invited 12 high-school seniors admitted for September 1989 to my home to meet with three current MIT students home at spring break. Had a great meeting. My Education Council group each had one or two on the admitted list."

I received a letter of special interest from **Alfred C. Wu** of Glen Cove, N.Y. He writes, "I am looking forward very much to the big reunion next year. The following is something I am doing for that great day: I have started a memorial scholarship fund for **Schrade Radtke.** I invite classmates to participate. I saw a lot of Schrade during his last years. We shared some consulting work. The best part was joining a tour of China with Schrade and Dembe, highlighted by Schrade bargaining for religious artifacts outside of a monastary in Tibet." If you would like to join in this fund, Al's address is 2 High Pine, Glen Cove, NY 11542.

A very nice letter from **Winfield (Tex) H. James** of Larchmont, N.Y., briefly reviews his activities since graduation. He began at the *New York Daily News,* but left in 1942 to serve in the Ordnance Department at Aberdeen Proving Ground, Md., until his discharge as a captain in 1946. He returned to the *Daily News* and worked his way up as business manager, circulation director, executive vice-president, president, and, in 1973, publisher. He retired from that position in 1980. He found his career at the *Daily News* interesting, exciting, and totally absorbing, and it brought him many rewards, including valued and lasting friendships. It also provided him the opportunity to serve on the board of the newspaper's parent company, the Tribune Co., as well as several other affiliated firms. Since retirement, he has been involved in various civic projects in New York City, including service on the board of the Regional Plan Association, and with other community organizations. He was married in 1944 to Marian Perry, Wellesley '43. Their four children and six grandchildren are scattered along the East Coast from Boston to Washington. Part of the winter months are spent at their retreat on one of the out islands of the Bahamas; in the summer they are usually in Little Compton, R.I.

Unfortunately, we must report some deaths at this time. **Allan W. MacKay** of Mt. Royal, PQ, Canada, died in January 1988. We have no further information. . . . **Joseph L. Shill** of Canaan, N.Y., passed away on April 1, 1989. A news item in the *Berkshire Eagle* of Pittsfield, Mass., states that Joseph was elected tax assessor in New Lebanon in 1987. Prior to his retirement in 1981, he was a mechanical engineer for Nevis Laboratory of Columbia University in Irvington-on-Hudson, N.Y. For several years he had been a volunteer energy consultant for the town of Greenburgh in Westchester County, representing the town as intervenor at the Public Service Commission hearings on electric and energy rate increase cases. He leaves his wife, two daughters, and two grandchildren.

On April 12, 1989, **Thomas P. Bowman** of Southbury, Conn., died at Waterbury Hospital. He was a retired vice-president of the Los Angeles-based Ralph M. Parsons Co. and formerly was assocaited with the Foster Wheeler Corp. He leaves his wife, three sons, and three grandchildren. The class extends its sympathies to all the families.

There are more replies to the 50th reunion questionnaire. **Paul V. Bollerman** of Englewood, N.J., and Highland Beach, Fla., writes: "Since retiring from my firm, Pyrometer Instrument Co., Inc., which I sold in 1980, I have enjoyed the fruits of leisure in New Jersey and Florida with one or two extended trips each year to Europe, Africa, South America, or the Far East. Carlene and I look forward to the 'big one' in 1990."

John J. Casey writes from Port Washington, N.Y., "Where did the first 50 go? Let's do it again! I have worked for four airlines, one aircraft manufacturer, and two consulting firms. Four children and six grandchildren. Sail racing is my action."

From Palm Coast, Fla., **Arnold Copeland** notes, "We are now living in Florida and Pennsylvania, enjoying the best of both worlds! Three of our four daughters are married (two living in Massachusetts), and we now have eight beautiful grandchildren. In 1981-1982 I was a vice-president of the National Society of Professional Engineers, and chairman of the Construction Practice Division, but have not been active recently."

Dave Fleming lives in Chatham, N.J., and says, "42 years with Union Carbide. Now retired. Three daughters, all married, and five grandchildren. My son, John, is following family engineering tradition with SB and SM from MIT. My wife, Elaine, and I never have a dull moment between house projects, golf, travel, and family."

Maurice E. Flynn, Jr., is retired and living in Alexandria, Va. His suggestion for the reunion: "Try to get Sally Bittenbender to read one of her poems. She was a charming addition to the 45th! You can tell her I said so."

From Mirror Lake, N.H., **Robert V. Gould** says, "We're enjoying retirement here in New Hampshire, where we built a summer cottage on Lake Winnipesaukee many years ago. Retired in 1980, after spending three years in Holland for Sperry. There we developed a new vessel traffic management system for the Port of Rotterdam—an exciting way to top off a satisfying engineering career. Now keep busy flying our Bonanza around the country, skiing, finished our passive solar home, and spending the summers at the lake cottage. Would welcome visits from classmates; we're in the Wolfeboro, N.H., phone book. Look us up!"

Robert S. Harper retired in Greenfield, Mass., in 1977 from Greenfield Tap & Die—TRW—as vice-president and general manager. He is active in SCORE, SBA, local Historical Society, and the local church.

Edward G. Hellier, from Micaville, N.C., writes, "I retired from NRC, Inc., Newton, Mass. Am now trying to get a degree in botany from Mars Hill College. Nancy and I like to travel; we went to the Galapagos in April."

From Stamford, Conn., **Robert S. Hess** notes, "This is a busy year for us. We'll be moving south—all the way to the Philadelphia area! Then, shortly after we move, we come back to Stamford for our younger son's wedding. How's that for planning!"

Willard L. (Bill) Morrison is still active in Winston-Salem, N.C., as president of two companies—Microban Products Co. (antibacterial plastics), and Advanced Heating Systems (hydronic electric baseboard heating units).

From Idyllwild, Calif., **George E. Niles** writes, "Remarried, most happily, in 1974 after having retired in 1970. First worked for Mead Corp., papermakers, then for Monsanto organizing their new Paper Chemicals Research Group. Ten years there and left for Emerson & Cuming, Inc., Canton, Mass., as microwave test engineer. Equipped new Belgian plant and initiated production of resins and microwave absorber, 1965-1969. Built largest antenna test chamber in Europe at that time, for the Technical University of Denmark, in Lundtofte, a suburb of Copenhagen. Now retired and building 1,800-square-foot addition to our home in the lovely mountain village of Idyllwild in the San Jacinto Mountains.

Paul W. Witherell writes from Raynham, Mass., of the death of his wife Norma on June 19, 1988. His stroke in August 1985 left him with mobility and transportation problems, but he plans to attend the reunion if he can get there. He expresses an interest in today's students—their problems and concerns, and what we can do to help them.

George W. Wolfe has been semiretired in Waban, Mass., for several years, after closing down his electrical construction business at the end of 1975. He keeps quite busy between working for his brother two days a week as a travel agent, and being active in community affairs in the Boston area. He is looking forward with great anticipation to the 50th!

Keep those letters coming.—**Richard E. Gladstone,** Secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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Robert D. Taylor died October 1988 of complications of diabetes at Spaulding Rehabilitation Hospital. He was assistant director of the property office at MIT. He worked for the Institute in various capacities since 1943. Bob was an amateur radio operator, a former member of the Boxborough School Committee, a member of the town's volunteer fire department, an organizer of the Boxborough Grange Fair, and treasurer of the Massachusetts Unidentified Flying Objects Network. He leaves his wife, Marian; two daughters, a son, and four grandchildren.

Henry L. Pohndorf reminded me that we last saw each other at a theater party in Chicago in 1942. Henry was a theater enthusiast at MIT, an invaluable co-director of the Drama-shop. After our last encounter he sailed as a naval officer in the South Pacific. I quote: "I then put my roots down in the San Francisco area. In 1988 we moved to a rather rural environment in Napa Valley. For some 15 years our family has spent four months at our lakeside estate on Lake Pend Oreille located in the north panhandle region of Idaho, and four months on Maui. June and I have two children and one grandchild.

"Early in my career I became fascinated with the dynamics of the lung, and experimented with new medical techniques in the treatment of diseased lungs in cooperation with many medical universities around the world."

Henry developed a respirator that has saved thousands of lives in some 45 nations. Castro demanded 100 respirators during the Bay of Pigs prisoners exchange program in late 1962. "Luck was on my side during the research, testing, development, and manufacture of this product. Sales did not require advertising. There are 20 patents relating to medical respirators in my name. I have been the co-founder of two corporations and a charitable foundation. The thought of saving so many lives is gratifying. In 1972 my family voted me down and I sold out all of my interests."

Henry is still very involved in Boy Scouting and serves on the board of three Boy Scout councils and concerns himself primarily with the out-of-doors activities. In the last 15 years Henry has sponsored an exchange of 66 Scouts between Maui and California. He swims or bikes every day.—**Joseph E. Dietzgen,** Secretary, Box 790, Cotuit, MA 02635

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Bridge here with Francine and **Jim Stern** last night. This game has been going on ever since Francine was "imported" from Grenoble in France in December 1945. Both of their children, Steffie and Kiki, run National Photo Color, a high-tech family business in Mamaroneck, N.Y. The pinochle game, which dates back to New Rochelle High School, is also still in play, with **Alan Katzenstein** as an active contributor. Was going to get this week's reading from Alan, the guru of acid rain, but he and Rhoda are vacationing in France and thus out of reach. More on this in our next notes.

Bob Greenes sold his oil-distributing business and is now busier than ever as a petroleum consultant. Bob works with the petroleum industry associations in improving the images of the producers and distributors of oil products. He's also a trustee of the Village of Scarsdale and chairman of the Finance Committee overseeing a $15 million village budget. . . . **Harvey Kram** is still at work as executive vice-president of Leviton but wintering in Florida.

Just eked out these notes by telephoning around my own neighborhood! If you are interested in a little better geographical breadth of information, let me know where you are, who you've seen, and what you're doing, huh?—**Ken Rosett,** Secretary, 191 Albermarle Rd., White Plains, NY 10605

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I regret that our only items of news this month are obituaries.

In March, we lost **Warren L. Knauer,** of Winnetka, Ill. Warren was a graduate of Course IX, and later earned a master's degree at the University of Chicago. He is survived by his wife.

Also in March, **John M. Watts** (Course XIII), of Mystic, Conn., passed away. John had a distinguished naval career in ship construction, retiring in 1963 as a lieutenant commander. He considered the high point of his career to be his work as ship superintendent on the carrier *Oriskany* throughout its construction at the Brooklyn Navy Yard, following World War II. Two of his sons were christened aboard the *Oriskany.* From 1963 until a second retirement in 1984, he was employed at Electric Boat Co., Groton, Conn. He was active in his church, the Retired Officers Association, and as a Cub Scout leader. He is survived by his wife Dorothy, five children, and 11 grandchildren.

Dick Feingold has written to complain that the class secretary edits all the meat and potatoes out of his letters. But, of course, that isn't news.

By the time you read these notes, the Great Albuquerque Off-Year Class Reunion and Balloon Ascension will be history. I'll report on it in due course.—**Bob Rorschach,** Secretary, 2544 S. Norfolk, Tulsa, Ok 74114

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The 44th reunion in Cambridge and Bermuda was a great success. Everyone who attended wished there was more time to enjoy the company of classmates and their wives from previous reunions and to meet others who hadn't been to a reunion before. This was a warmup for the 50th in 1994, and we look forward to seeing all who didn't attend this one. Watch for details of a mini-reunion in about 18 months.

Class election of officers to serve for the next five years was held in Bermuda. **Norman Beecher** was chairman of the nominating committee. The following slate was elected unanimously. President, **Edgar Eaton, Jr.;** class agent, **Al Picardi;** vice-presidents, **John Gardiner, Al Hildenbrandt, Bernard Rabinowitz, Ed Roos, Melissa Teixeira,** and **Dick Whiffen;** international vice-president, **Jose Aquila;** treasurer, **Stanley Warshaw;** co-secretaries, **Andrew Corry** and **Louis Demarkles.**

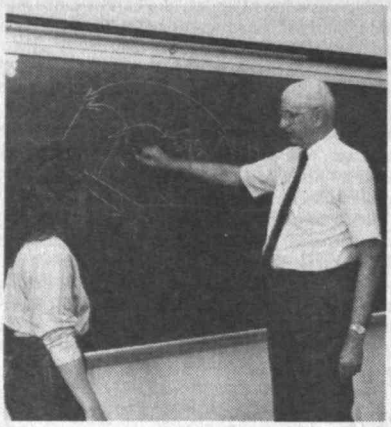
Tom Lawson is enjoying retirement in Naples, Fla. Nancy and he enjoyed a marvelous safari in Kenya and Tanzania last July (1988) and looks forward to an MIT-sponsored cruise on the Seine River in France this summer (1989). . . . **Bill Cooley** writes from Fairfax, Va., that he is serving as program chairman for the "Design in Engineering Education Division" of the American Society for Engineering Education, 1988-1989. . . . **Bill Jack** reports that he enjoyed his professional career but retirement is better.

Navy captain **John Woolston** in Honolulu, Hawaii, reported that after being manager of government projects for Bechtel Civil, Inc., in San Francisco for several years, he was sent to Australian Warships Systems as general manager to compete for the Anzac Frigate contract. After document submittal, he returned to Honolulu. He expects to retire soon but looks forward to more adventures as a consultant.

Ed Eaton, Jr., continues as chairman of Caroone-Lorrain Industries Corp. in New Jersey, but in a nonexecutive capacity. It takes about 25% of his time. He started a financial-planning practice in 1989 consisting of one senior partner, two junior partners, and three associates. He is enjoying it and getting some clients. His long association with fundraising for MIT continues, as well as serving on civic boards, mostly in the health field.

We regret to report the passing of two classmates. **Ian B. Bennett** in Irving, Tex., on December 29, 1988, reported by his daughter, Catherine Bennett. . . . **Harvey A. Cix, Jr.,** in Greensboro, N.C., on March 16, 1989, as reported in the *Stanley News & Press* of Albermarle, N.C. He is survived by two sisters. We extend our sympathy to their families.

Randall Pratt retired from Du Pont in 1972 at 52 after 27 years in R&D on agricultural-chemical products—mostly herbicides. He then joined the University of Delaware in the chemical engineering department as engineering computation specialist running computer projects for all the



John R. Mather, '47, department chairman and professor of geography at the University of Delaware, received an excellence-in-teaching award at Honors Day from the University Alumni Association and the Christian R. and Mary F. Lindback Foundation. Selection is based on thoughtful and enthusiastic evaluations written by students.

students. In 1983 he underwent an operation for gall-bladder removal and in 1985 for colon cancer, and retired a second time in 1985. He now enjoys his home computer and keeps busy as president of the 33 condominium units where he resides. Recently while leaving the hospital after a check-up, Flo and he were hit in their car by another running a red light, so back to the hospital. Both are home now recovering and taking it easy for a while.

We need material for the notes, so drop us a line.—Co-secretaries: **Andrew Corry,** P.O. Box 310, W. Hyannisport, MA 02672; **Lou Demarkles,** 77 Circuit Ave., Hyannis, MA 02601

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No news this issue, so we have a few class biographies. Here's **Ted Huechling's,** for example: He writes about the passing of long-time friend **Clarence Lyon,** a V-12, VIer like Ted, and about Ted's love, marriage, and life with Clarence's widow, Patsy, since 1977. He's been with Arthur D. Little since 1959, though he may have retired by now. Ted prepped at Francis Parker School in Chicago and still does things for them out of gratitude for their awakening his interests in literature and music and art. How about athletics? You name it—basketball, crew, and later sailing, skiing, squash, and of course tennis, which we always see him playing with neighbor **Jim Craig** at reunions. He and Patsy have a place in Brewster (on the Cape) which they share with their family—three children each, and plenty of grandchildren. He hopes to take up golf and travel, and I hope he makes it to Denver before the 50th.

Robert Michaud transferred from Bates and came out of Tech an electrical engineer, later to received his SM. He tarried a while as a research assistant in the Telemetry Lab before moving on to Raytheon and into computers in the early 1950s. Along the way, he hit the trip wire at a Watkins Glen Grand Prix, and after that his fortunes rose and multiplied, so that by now he has gathered a large stable of European sports and racing cars. Professionally, he has founded computer hardward and software companies; the most recent is Hardware Development Interactive Images, Inc., where he directs productions of graphic interface tools for Detroit's "big three," who like graphics that are simple enough for people on the line to use. Robert has been singing serious music in the Boston area for years (as **John Gunnarson** can attest). Robert and Ellen, an artist, live in Bedford and spend weekends sailing on Buzzards Bay, when his automotive activities don't get in the way. He hopes to write more automotive articles and maybe even the Great American Novel when he retires.

It all began after the rites of passage with those V-12 rowdies of Course II in the 2-46 class, after which **Bob Hoffman** returned to North Jersey to work for Worthington Pump for the next 23 years. In 1950 he married Marion, who got a jump start by helping him build their house in Madison while they were engaged—and where they still live, I think. After leaving Worthington in 1969, Bob joined Leisuredyne in Morristown to develop new products. During the 1970s, he had time to get his PE and go into consulting until Hartz Mountain, one of his clients, talked him into a full-time job setting up their technical service department. Five years later, he took early retirement, which allows him to pursue management of his investment properties. Bob and Ellen put all five sons through college, and after that Ellen got her real estate license and became a travel agent.—**Jim Ray,** Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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Our thanks to **Claude Brenner** for sending us information on a number of classmates acquired during a fund-raising telethon last spring: **Aaron Newman** is retired and does a fair amount of traveling when he can. In the spring of 1987, he and his wife toured Italy, principally Padua and Verona, staying at Elderhostels, which they heartily recommend. By the time this is printed, they should have their first grandchild. . . . **Leon Scharff** retired four years ago after a career in the Defense Department. He is now enrolled at the University of Maryland studying molecular biology. He's doing it just for the "intellectual experience." He points out that the field is so new that learning often coincides with developments—there's not much in the past to draw on. . . . **Hal Brodsky** enjoyed a long career with Fafnir Bearings, becoming president and CEO. Fafnir was recently acquired by Ingersoll Rand; Hal continues on the board and as a business advisor. He serves in similar capacities with a number of other companies as well.

Bill Little is actively engaged in real estate development in Charlotte, N.C., in partnership with Bill Mitchell, '49, who makes his home in Toledo. . . . **Tom Dorste** founded a new firm, Plus 4 Architects, in Indianapolis a couple of years ago. The firm's particular expertise is special atmospheres for libraries, laboratories, and other controlled environments—in the industrial, commercial, and academic fields. The company is very successful and Tom is most enthusiastic about the future. . . . **Al Barsta** graduated from MIT with a degree in aeronautical engineering, then got a law degree, and then founded a women's apparel business! He's been running that for 40 years. His son Al, Jr., went to RPI and is president of Barsa Consulting Group, software consultants; his daughter, Barbara, is a vice president of American Express and heads their corporate card division.

Sebron Haley transferred to MIT from the University of Texas as a sophomore. He was discharged from the Navy as a pilot with the rank of commander on a Friday, drove up from Texas with his wife over the weekend, and enrolled at MIT on Monday. That was in mid 1945, and he was 30 at the time. Thus he was much older than most of us and considerably more mature than his Course XVI classmates. He had no civilian clothes and wore his uniform for the statutory 30 days until he could assemble a new wardrobe! He spent his career in operations analysis at Strategic Air Command Headquarters at Offut Air Force Base. He retired three years ago and lives in Omaha. . . . **Walter Benults** sends along a brief note simply saying he's enjoying teaching mechanical engineering at Wentworth.

We received notices of the death of two classmates this month, unfortunately with no details in either case. **Maitland Baker** died in December 1988; he lived in Kingston, Tenn. . . . **Robert Solnick** died last year; his home was Corona Del Mar, Calif.—**Robert E. McBride,** Secretary, 1070 Pilgrim Pkwy., Elm Grove, WI 53122

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President Bush appointed **Don Atwood,** to be the No. 2 man responsible for the Defense Department's day-to-day operations at the Pentagon. As GM's vice-chairman in charge of military, electronics, and data processing, Don won a reputation among his peers as a steady, low-key executive with a deep knowledge of scientific and engineering issues. An article in the *New York Times* contained the following quotes about Don: "He helped lead the efforts to get our components groups competitive, in a patient, direct way." "He was very thoughtful dealing with people, while still driving the process forward." "I've dealt with thousands of businessmen; Don Atwood clearly is one the smartest and most able." Although Don's record at GM might otherwise have qualified him for an opportunity to run the entire company, his 65th birthday and mandatory retirement date in May 1989 fell a year earlier than that of Roger Smith, GM's current chairman. Don was born in Haverhill, Mass. He and his wife, Sue, have a daughter and a son.

John Little was named Institute Professor, by the MIT faculty, an honor reserved for those who have made exceptional contributions over a long period of time to the scholarly, educational, and general intellectual life of the Institute and to the wider academic community. The ad hoc faculty committee that reviewed John's nomination cited his pioneering contributions and said, "In the field of marketing science, which John virtually created and which became his main area of work, he wrote a number of original and important papers on the idea of optimal adaptive control of marketing programs. He has been a valued teacher and role model. One of his colleagues described his work in pulling together the behavioral and policy sciences fields in the Sloan School as 'heroic.' Another described him as a 'master teacher.'"

Besides marketing, John has done research in mathematical programming, queuing, traffic control, and decision support systems. Part of his work has been focused on public systems problems, including citizen feedback, education, and transportation. John and his wife, Elizabeth, live in Lincoln. They have four children.

In 1969, **Bernie Gordon** founded Analogic, a manufacturer of precision instrumentation and high speed computing equipment. As Bernie observed the shift in how engineers were trained, he made several attempts to persuade existing colleges to train hands-on project engineers and finally, in 1985, created the Gordon Institute to provide this training. Students at the Gordon Institute are sponsored by their employers and study humanities, engineering, and business to earn their MS degrees in engineering management. Along with deans from MIT, Northeastern, and Boston University, **Graham Sterling** attended the second annual commencement of the Gordon Institute. Ten students were graduated. The keynote speaker was Dean Charles Hutchinson of the Thayer School of Engineering at Dartmouth. Bernie hopes to continue the 40 percent annual growth rate until enrollment builds to 100-200 students annually.

Peter Guercio was elected a vice- president of Ametek, Inc. Peter is general manager of Ame-

PHOTO: ROBERT COHEN

tek's Specialty Metal Products division, which he has managed since its inception in 1963. Peter and 130 employees joined Ametek when it acquired the business from Pfizer, Inc., in 1988. They produce ultrahigh purity metals and precision alloys supplied in powder form, strip material, or composite metals to the electronics industry and to manufacturers of aerospace, medical, appliance, gourmet cookware and automotive products. Peter and his wife, Jane, live in Scarsdale, N.Y. They have three children. . . . **Jim Hourihan** was interviewed by the *Marblehead Reporter.* Jim is a life-long resident of Marblehead and has been a member of the town finance committee for 15 years and chairman for nine years; for the past two years, he has also been a selectmen. Marblehead's government is decentralized and has separate boards, committees, and commissions that budget and control their own expenses. Jim has worked to consolidate town functions and achieve operating savings. . . . **Bob Gurney** is enjoying retirement. He recently visited his son, James, a freelance illustrator who frequently draws archeological "as it was" illustrations for *National Geographic.* Bob's sixth grandchild is due soon. . . . **Ken Stickney** reports the death of Donald Sabean, '46, of Pembroke, Mass. . . . **Russell Lawton** remarried in 1988 a high school friend from Fall River who was also living in California. Russell is working on a scholarship fund for his 50th high school reunion in 1991.

Neil Helmers retired from Du Pont in 1985 after 35 years of environmental and management responsibilities. He had vacationed in Falmouth, Mass., since the 1950s, so he retired there in 1985. Neil is a relatively new member of the Planning Board of Falmouth. He was interviewed by *The Enterprise,* Falmouth's newspaper about local laws relating to water quality and zoning. . . . Bev and **Dave Freedman** have completed their seventh project helping bakeries in Third World countries. This time, Dave helped start up a new bakery in San Jose, Costa Rica. When they arrived, the project was behind schedule, but Dave stepped in as construction foreman—and within two weeks, they were baking bread. Bev reports on Costa Rica's democratic government noting that the secretary of state is a woman, there is no army, and they use federal taxes to pursue social reforms. Bev and Dave climbed a volcano in Costa Rica and observed a drop in air temperature from 74 to 40º. Dave was sorry to learn of the death of our classmate, **Nick Caldwell.** Dave and Nick became friends in England as members fo the 452nd Bomb Group. . . . **Al Seville** saw **Harry Jones** and **Bob Turkington** at Technology Day last June. He missed seeing **Peter Saint Germain,** who attended a 50th reunion banquet as a representative of the Alumni Association. . . . This summer was my 20th year racing the International 110 sailboat. I attend weekend regattas about six times every summer. I have sailed without a crew and twice have put up the spinnaker by myself. **Jack Page's** wife, Imogene, crewed one weekend. I finish anywhere between last place and sixth place, but I always have a good time. In the evening after a race, my blood pressure is down 15 to 20 mm.

A mailing was sent in the summer to the entire class, outlining plans for reunions in 1991 and 1993. About 50 classmates have sent in responses, commenting about the plans and making suggestions. If you want a copy of the schedule of events and the response form, please let me know.—**Marty Billett,** Secretary and President, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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Chuck Miller has moved to Sedona, Ariz., after two decades near Disneyland NE (AKA Washington, D.C.). He is active in aviation safety engineering and management consulting and made an appearance on a major TV network program, *Nightline.* . . . **Bernard Wasserman,** who received his SM degree with us in 1949, writes to advise "that I have been promoted to the position of vice-president, engineering, at Textron Defense Systems, Wilmington, Mass."

Among the more prestigious and useful organizations to which one may belong is the Council on Competitiveness in Washington, D.C. The Council is a private, nonpartisan group of 158 chief executive officers representing business, labor, and higher education. The presidents of 18 institutions of higher learning, including MIT, are members of the Council. The presidents or CEO's of Ford, Chrysler, IBM, Kodak, B.F. Goodrich, AT&T, Xerox, Pfizer, TRW, E.I. Dupont de Nemours, and Texas Instruments, to name a few, are active members. To this influential group has been added the name of **George N. Hatsopoulos,** chairman and chief executive officer of Thermo Electron Corp. in Waltham.

Richard J. Nickerson, 63, died on December 2, 1988, at J.B. Thomas Hospital in Peabody, Mass. Born in Lynn, Mass., he was living there with his wife, Anne T. (Grattan) Nickerson, at the time of his death. Dr. Nickerson was an associate professor at MIT from 1957 to 1962. From 1962 to 1985, he was a professor in the mechanical engineering department at the Stevens Institute of Technology in Hoboken, N.J., and a consultant with numerous engineering firms on the East Coast. At Stevens, he was given the Freigang Award for best teacher of the year in 1970. In addition to his expertise in thermodynamics, he was an historian, fluent in Latin and Greek, and a member of ASME and the Sierra Club. In addition to his wife, he leaves a son, two daughters, and three grandchildren. I am sure I speak for the class in extending our belated condolences to Mrs. Nickerson and the family on the loss of our distinguished classmate.

Daniel W. Greenbaum is CEO of Vollmer Associates Consulting Engineers of New York City and project director for the Westway replacement project in that city. . . . On April 17, **Bruce Campbell,** whose name we see often in print and of whom we have written more than once, stated that he has stayed in the transportation field for his entire career. "In 1987 (May Day!), I restarted Bruce Campbell Associates in Boston. We have had some interesting projects: representing the City of Boston for the Third Harbor Tunnel/Central Artery project; the expansion of Shopper's World in Framingham and Jordan Marsh in Boston for Campeau; the Great Woods in Mansfield; 1988 U.S. Golf Open—full build-out of Logan International Airport; many others. . . . **Sherwood Stockwell,** FAIA, was recently honored when his firm, Bull Volkmann Stockwell, Architecture & Planning, San Francisco, was the recipient of the 1989 Firm Award presented by the California Council of the American Institute of Architects. The Firm Award recognizes a California architectural firm that has produced consistently distinguished architecture for a period of 10 or more years. The firm is internationally known for its expertise in alpine architecture and planning, and hotel/resort design.

As many of you may recall, we had a 40th reunion back in June. I'm told that a great time was had by all. However, I couldn't be there and asked **Frank Hulswit,** newly-elected assistant secretary, to cover the event. Herewith follows Frank's report: According to the Black Point Inn registration records, 110 persons associated with the MIT Class of 1949 were in attendance at this portion of our 40th Reunion. As advertised, the facilities, service, and food were uniformly superb (although the staff on one occasion proved incapable of mind-reading when not informed of needs, as Messrs. Toohy and Holmes can testify). The weather, unfortunately, was not: rain Saturday morning and cloudy weather for most of the weekend. Those few of us who stayed 'til Monday lucked out and enjoyed a perfect day.

The weekend started off with cocktails in the beautiful Bayview Room: spacious with high ceilings and large picture windows overlooking the bay. Next was a classic lobster-bake dinner. After dinner, we convened for our quinquennial class meeting and election of new officers. **Paul Weamer,** as chairman of the nominating committee, reported a slate of officers which was elected by acclamation, as follows: president, **J. Thomas Toohy;** regional vice-presidents: West, **George Piness;** central, **John W. (Jack) Barriger;** South, **E. Milton Bevington;** East, **Leonard F. Newton;** New England, **Russell N. Cox;** treasurer, **Demetre P. (Mickey) Ligor;** secretary, **Fletcher Eaton;** assistant secretary, **Frank T. Hulswit;** and class agent, **James Veras.** Before we leave the matter of class business, it should be noted that **Tom Toohy** and the reunion gift committee, representing 82 classmates, presented a gift of over $5.3 million to President Gray at the Technology Day luncheon on Friday. Many thanks to all these people.

Saturday morning, after a delicious breakfast, the foul weather sent many on unplanned expeditions to LL Bean's in Freeport, Old Port in Portland, or Maine Mall (120 stores) in South Portland. At noon, we discovered that Black Point Inn outdoes itself with a gargantuan luncheon buffet followed by an incredible dessert table. In the cloudy Saturday afternoon, several of us played nine holes of golf and the hard-surface tennis courts were busy. Others explored the Cliff Walk around Prout's Neck and fought off clouds of mosquitoes on the board walk through the Bird Sanctuary. The indoor swimming pool was also occupied most of the afternoon. Several took advantage of the available bicycles to tour the area. And almost everyone used the extensive lounge areas at some time to meet and schmooze with classmates and spouses.

Cocktails and a delicious dinner preceeded a class party, with entertainment by **Mickey Ligor,** assisted by the Boston-area "Class Mafia," and music by a local disk-jockey team of three, who kept the golden oldies coming for the balance of the evening. Sunday morning was winding down time for most, punctuated by two more excellent meals. By mid-afternoon, only 11 MITers and families were left to enjoy an extra day on Prout's Neck. For the Class of 1949, our 40th reunion was history.—**Fletcher Eaton,** Secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

50 40th Reunion

This month brings news that ASTM (American Society of Testing Materials) has honored two members of our class, **Carroll J. Johnson** and **William F. Maroni,** by naming them Honorary Fellows of the Society, along with being honored as recipients of the ASTM's Award of Merit. Carroll is the retired vice-president for engineering and construction for Friendly Ice Cream in Wilberham, Mass. He is now a resident of Brewster, Mass. Maroni is the manager of Building Materials and Assemblies for Factory Mutual Research in Norwood, Mass. Bill is a resident and native of Providence, R.I.

Shawmut National Corp. announced the appointment of **James A. Daley** of Simsbury, Conn., as executive vice-president of the corporation. Jim is the senior officer in charge of operations, data processing, and corporate services for Shawmut National. He is a resident of West Simsbury, Conn. . . . **Leo Sartori** is on sabbatical this year from the University of Nebraska at the Office of Arms Control, Department of Energy, Washington, D.C. . . . An honorary degree (Doctor Honoris Causa) in medicine was conferred on **George Santos** at the University of Munich, West Germany, in February. . . . The New York Patent, Trademark, and Copyright Law Association honored **John E. Anderson** as "Inventor of the Year." Dr. Anderson is a senior corporate fellow and a leading researcher in high temperature combustion at the Union Carbide Industrial Gases, Inc.—**John T. McKenna,** Secretary, 182 Midpine Rd., Box 376, Cummaquid, MA 02637

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Recipient of the 1989 Firm Award presented by the California Council of the American Institute of Architects is the San Francisco based firm of Bull Volkmann Stockwell. The award, presented for consistently distinguished architecture for a period exceeding ten years, was honoring the firm's reputation for site sensitive design. **Henrik Bull**, one of the principles, set the current direction of the firm through his design in the mid 1960s of the first resort condominium in California. They have since earned an international reputation for expertise in alpine architecture and resort hotel design.

Elected as a director of the Unifirst Corp. of Wilmington, Mass., **Albert Cohen** continues to serve as the chairman and CEO of the Electronic Space Systems Corp., of Concord, Mass. . . . Newly elected to the prestigious National Academy of Sciences, **George B. Field** is currently the Wilson Professor and Smithsonian Senior Scientist at Harvard University. . . . Having retired as corporate vice president of Circuit City Stores, **Eugene E. Koch** now owns and operates a travel agency in Newport Beach, Calif. He is also the current president of the Rotary Club and vice president of the Air Force Association of Orange County. His travel agency specializes in special interest technical tours. The focus of his attention is his beautiful 1-year-old granddaughter.

Consulting work following his retirement from Grumman in 1987 seems to have gotten the best of **Robert Kress.** As a result, he has come out of retirement and is now Grumman vice president of advanced programs. . . . After joining Welch Allyn, a major manufacturer of medical diagnostic, bar code, and industrial inspection equipment, **William Miller** is currently their chief corporate development and technology officer. . .

One of the candidates for school board in the Christina district of Delaware is **George Purpur, Jr.** George is the finance director of the Sussex County Council.

With good reason to be proud, **George E. Schultz** has sent word of the achievements of his son Peter, who has just received the prestigious Alan T. Waterman award from the National Science Foundation. Peter, who pursued postdoctoral work at MIT, has already done some outstanding work in demonstrating the catalytic behavior of antibodies and in helping to create new enzymes that can cut DNA at specific sites along the length of the molecule. . . . After retiring from a teaching career in electrical engineering 11 years ago, **George L. Thompson** has finally reached the age when he can receive retirement checks. George writes of his missing the days when he was a member of the MIT Track Team coached by Oscar Hedlund. . . . **Amar Bose's** firm announces a complete stereo system that can provide each room of an upscale home with a tailored optimal sound quality.

Sadly, I have to report another loss to our class. On April 27, 1989, **Paul F. Murray,** M.D., passed away. Dr. Murray was a podiatrist and served for many years as the health director of the Watertown, Mass. Health Department. We extend our condolences to his family.—**Martin N. Greenfield,** Secretary, 25 Darrell Dr., Randolph, MA 02368

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Swraj Paul kindly took the time to write about himself for us: "After leaving MIT in 1952 I went back to India to join my family's company, the Apeejay Surrendra Group. I married my wife, Aruna, in 1956, and in 1957 we had twin boys, Ambar and Akash. Our daughter Anjli was born in 1959 and a second daughter, Ambika, in 1963. Our third son, Angad, was born in 1970 and he is presently studying economics at MIT.

"Unfortunately Ambika developed leukemia when she was 2 years old, so in 1966 we decided to move to London to get the best medical treatment for her. Sadly, we lost Ambika in 1968, and I decided to stay in England."

Swraj Paul built up a business, Caparo Group, over the years. It is primarily engaged in making welded tubing and pipe, and it now has plants in North America, Asia, and Europe. It also has several other lines of business, the most surprising of which is a group of tea plantations that produce 25 million kilos of tea a year. Paul now has five grandchildren and remains closely involved with MIT, where he funds a scholarship for undergraduate students. He was given a Corporate Leader Award by MIT two years ago.

Gene Rapperport says he is still running a materials and design consulting firm, and now has his oldest son with him. He adds, "I've mellowed over the years, so now we work well together. Also, he knows his computer stuff." . . . **Dirk Plummer** notes that he is still studying and is sure most of us are, also. Well, yes—computers, most likely.

I am sorry to say that **James S. Gibson** died last March 15, in Kearny, N.J., his life-long home. A chemical engineer, he worked for Fabricolor Co. for three years and for National Lead for 30 years before that. He is survived by his wife, Marina.—**Richard F. Lacey,** Secretary, 2340 Cowper St., Palo Alto, CA 94301

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Wally Reid reported that he has retired from the Air Force and the inn business. He is still working as an architectural designer, consultant, and appraiser. He and his wife Virginia have 11 grandchildren. They travel often, including trips last year to Europe, the Maritimes, and southern U.S.

Jim Sullivan reported that he retired from IBM and is now consulting in manufacturer's logistics systems. . . . **Jay Berlove** stopped by. He was in town for a conference and was also looking for information on housing for his son, who is planning on working in northern Virginia after graduation from Carnegie Mellon University in June.

The May 1989 issue of the *Nucleus* reported that Dr. **Robert Stolow,** a professor of chemistry at Tufts University, has served as chairman of the department of chemistry for two periods, 1979-1982 and 1986-1989. His research interests include stereochemistry and conformational analysis, nmr spectroscopy, physical organic chemistry, and computer-assisted synthetic analysis.

A Boston University news release reported that BU and MIT researchers are collaborating in a NASA project that seeks to measure the electrical charge emanating from the sun. The MIT scientists, who are under the direction of Dr. **Alan Lazarus,** will design and produce two gold-plated sensors called Faraday cups to house BU's electrical-current measuring devices. The measuring devices will be used in a solar-wind experiment planned to be placed at the "Largrangian Point," where the gravitational pull from the earth and sun are equal, and which is the best location to collect long-term data on the solar wind.

And finally, it saddens me to report the passing of two classmates. **Alcon E. C. Gallagher** of 11925 W. 18th Ave., Lakewood, CO 80215, died November 6, 1988. He is survived by his wife Jane. . . . Also, **Rafael J. Martinez** of Forrest Hill St., G13, Garden Hills, Guaynabo, PR 00657, died April 5, 1989. He is survived by his wife Julia. I know you will join me in extending our heartfelt sympathies to their families.

In closing, I'll repeat my plea for news about your successes, promotions, retirements, travels, and burning interests. Until next time, I'll be waiting for your letters.—**Gilbert D. Gardner,** Secretary, 1200 Trinity Dr., Alexandria, VA 22314

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Our 35th reunion has come and gone, and everything from the Pops concert through the visit with Priscilla and **Paul Gray** to the post reunion party on Nantucket were pleasant and most enjoyable. The weather was somewhat damp and cool, but the class spirit was just the opposite.

Class officers for the next five years were elected. They are **Joe Blake,** president; **Herb Slater** and **Frank Laplante,** vice-presidents; **Ed Eigel,** Secretary; **Bob Anslow,** reunion gifts chairman; **Mickey Sama,** class vintner; **Don McGrath,** assistant class vintner; **Bob Warshawer,** permanent reunion chairman. **Mickey Sama** was recognized for his contributions as class vintner, and **Harvey Steinberg** was congratulated for his work as class president for the past five years.

Bob Warshawer received the Silver Beaver Award (No. 1114) for his outstanding contributions to the Institute and the class over the years. The award is rarely given, but Bob clearly deserves it. On the lighter side, **Joe Blake** and **Joe Scheller** received recognition for the earliest registrations for the reunion.

Attendance at the reunion was very good—102 took part in the Friday night reception and dinner, and 33 continued the party on Nantucket after the main event in Cambridge.

Among the news items picked up at the reunion and elsewhere is the word from **Dick Wallace** that he retired from Honeywell in Albuquerque last January; he was vice-president for engineering. . . . **Dan McNally** retired this summer from his position as professor of mechanical engineering technology at Purdue University. Dan's daughter Carol is now in her junior year at Purdue, majoring in mass media communication. . . . **Arnold Tubis** is also at Purdue, where he was named head of the Department of Physics last March. He is a fellow of the American Physical Society and a member of the Acoustical Society of America and the Association for Research in Otolaryngology.

We are very sorry to have to report the deaths of two classmates. **Dave Leslie** died last February in California. He had been the managing director of architecture and engineering for Children's Hospital of San Francisco. . . . **Archie Spratt** died last December in St. Louis. He was an engineer for the U.S. Army. Our sincere sympathy goes to Dave's and Archie's wives and families.

More from the reunion and other sources next issue.—**Edwin G. Eigel, Jr.,** Secretary, 33 Pepperbush Lane, Fairfield, CT 06430

55 35th Reunion

Plans for the 35th reunion continue to move at a rapid pace, with 17 Reunion Committee members attending a planning meeting at the newly renovated MIT Faculty Club in early June. **Pete Toohy** got the prize for coming the greatest distance—he managed to schedule a business trip to coincide with the meeting. Who do you suppose will be coming the greatest distance to the 35th?

The committee has expanded to include several spouses—Polly Attridge, Jan Ehrlich, Edie Greene, Nancy Peterson, and Debby Saliba are all actively (and for the first time formally) participating in the reunion planning. It has also expanded to include two regional members—**Jim Eacker,** Maryland, and **Don Welsh,** New York. We expect to add more regional committee members as we get closer to the reunion date to organize and participate in a telethon in the spring.

Clippings furnished by the Alumni Association this month include a *Wall Street Journal* article announcing the addition of treasurer to **Allen H. Wahlberg's** title so that he is now vice-president, treasurer, and chief financial officer for Turner Corp.

Norman F. Ness with the Bartol Research Foundation at the University of Delaware, also has a new hat as a member of the National Research Council's Space Studies Board (SSB). The National Research Council, as most of you know, is the principal operating agency of the National Academies of Science and Engineering. In a reorganization of space-related activities, the SSB has

expanded its advisory role beyond the NASA Office of Space Science and Applications to other offices of NASA that have an impact on the agency's long-range research strategy, as well as to other agencies with space interests.

I am delighted to report that my partner in these class notes, **DuWayne Peterson,** has another important new role with the MIT Corporation as a member of the Corporation Committee on the Presidency, which is chaired by Carl Mueller and has eight members, including DuWayne. The committee is charged with presenting to the MIT Corporation's Executive Committee, for appropriate action, a nominee for president of the Institute effective July 1, 1990, to replace Paul E. Gray, '54, who will be stepping down as president next June. The MIT faculty has selected an advisory committee of faculty members to assist the Corporation Committee in the search process. In addition, the Corporation Joint Advisory Committee on Institute-wide affairs has been asked to gather views from the wider MIT community on agendas and issues for MIT in the 1990s. I talked with DuWayne a few days ago about his new role, and he says he welcomes input from the class of '55 for this important task. If you ever wanted make your views known in the selection of an MIT president, here is your big chance!

Keep those cards and letters coming, and save those dates for our 35th!—Co-secretaries: **Robert P. Greene,** 100 Memorial Dr., 11-2A, Cambridge, MA 02142; **DuWayne J. Peterson, Jr.,** 201 E. 79th St., New York, NY 10021

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Alumni and guests met in May to continue plans for our 35th reunion. As of this writing, September 27-29, 1991, are the dates set for a campus-oriented reunion. Tentative plans were made for mini-reunions this fall in the Northeast, Chicago, and northern California areas. . . . **Bernado Blaschitz** writes that he is interested in the reunion plans. He says that everything is all right around Caracas, Venezuala, except maybe there's too much work to do. . . . Reunion co-chairman **Lloyd S. Beckett, Jr.,** left Polaroid, completed a MEd program at Lesley College, and now teaches math, science, and computers at the middle school level.

In 1988, **M. Philip Bryden** received the Donald O. Hebb award for distinguished contributions to psychology as a science from the Canadian Psychological Association, and a Killam Research Fellowship from the Canada Council. . . . **Charles R. Greene, Jr.,** started Greeneridge Sciences, Inc., in 1983, to conduct underwater acoustics research in the Artic. The company is named after Greene Ridge, a mountain in Antarctica, which was named for Charles as a consequence of his wintering over at Pole Station in 1958 as an ionospheric physics scientist. Greeneridge measures underwater sounds from oil exploration activities while biologists observe the reactions of whales. Work fell off after 1986 when the oil industry's interest in arctic offshore sites diminished, and Charles joined Science Applications Corp. to work on a harbor defense project. However, whale work has returned in 1989, and Charles now enjoys two jobs. . . . After 26 years at Dupont, **William A. (Bill) Peter** is now chief executive officer of his own medical software company, Data Med Clinical Support Services, in Minneapolis. Early retirement at age 50 was perfect for unleashing the entrepreneur in him. Bill finds Minneapolis a great city and a fast-growing center for new medical technologies.

Russell L. Schweickart finished work at NSF (Antarctic Safety) last June and again lives in Sausalito, Calif. Russ is president of the Association of Space Explorers (see his book, "The Home Planet"), co-director of U.S./U.S.S.R. Electronic Conference on Global Warning, and chairman of NRS communications. . . . **Samuel J. Singer** married Sue Bolt last November. They reside in Riverside, Calif. . . . **Dexter Wheeler** has given up living on land and has become totally acclimated to life aboard the 44-foot trawler yacht *Cubit* in Danversport, Mass. Dex works at Raytheon as an engineering section manager. . . . We are sorry to note the death of **Z. George Wachnik** of Silver Spring, Md., in March. George is survived by his wife Lucy, daughter Jeannette Kemp, and son Richard, '77.—**George H. Brattin,** Co-secretary, 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin C. Gross,** Co-secretary, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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Just had to shake loose from this summer's movie madness long enough to write the October column. Holy Ghostbusters, Batman, it's that time again! And speaking of dispelling myths, **Rudy Segovia** did just that when he spoke at Lehigh University this past spring about his native country in a talk titled "Columbia: Perception versus Reality." Rudy, a former health minister of Columbia, is the father of two Lehigh students, Jorge, '89, and Mauricio, '91. His lecture addressed the fact that Columbia is the only major Latin American country without a debt crisis and that its gross national product growth is the highest in the region. While candidly acknowledging his country's drug problem, he noted that it is a regional issue and that greater emphasis needs to be placed on reducing the demand, not just curtailing supply.

Michael Card, chief of the Structural Mechanics Division at NASA's Langley Research Center, has been selected as a Fellow by the American Institute of Aeronautics and Astronautics. Mike was cited for "outstanding leadership and sustained technical and managerial contributions in the fields of composite structures, minimum-wage design, thermal buckling, and general shell behavior under load." Mike received an SM and PhD in Engineering Mechanics from Virginia Polytechnic Institute. In 1985 he attended Harvard University's program for Senior Managers in Government. Mike and his wife, Joanne, live in Williamsburg, Va., and they have three children. . . . Also at NASA, **John McCarty,** director of the Propulsion Laboratory in the Science and Engineering Directorate at Marshall Space Flight Center, received NASA's Outstanding Leadership Medal. Since joining the Center in Huntsville in 1963, he has held positions of increasing responsibility including assistant chief engineer for the Space Shuttle Main Engine and deputy director of the Structures and Propulsion Lab. Mike and his wife Sandra have four children.

We were delighted to have a brief note from **Phil Friend** bringing us up to date. He writes: "I guess I have come full circle, as I am now treasurer of the MIT Club of Northern California. After MIT and Harvard Business schools, I spent some years in the aerospace and space science industries. Then, I started several technology companies in time sharing, personal-computer services and training, and health-care processing, all of which were subsequently sold or acquired. Following the untimely and early death of my wife, Pat, from cancer, I lived in Europe and traveled extensively. Currently, I am with another prominent start-up company, Sun Microsystems. I am living in Palo Alto and would be delighted to catch up with any classmates visiting the area.

Ken Whipple returned from his job as chairman at Ford of Europe and was promoted to president, Ford Financial Services. Ken was married in January this year to Kimberly Hoffiz. . . . Since our last update in 1986, Shelia and **Bernie Schneiderman** celebrated their 30th anniversary with a summer tour of Scandinavia. Their son Barry received an SM in engineering at Harvey Mudd College and has moved on to an MBA program focusing on international business at the University of Indiana. Bernie is with the Command and Control of the Naval Ocean Systems Center in Hawaii.

William Elvison is a research scientist at Bolt Beranek and Newman, but in his spare time he is a volunteer with the Lexington High School Guidance Advisory Committee. He also continues to serve on the Lexington Republican Town Committee. . . . **Bob Lee** reports that he is as active as ever in the Treasurer's Office at MIT. When not at the Institute, Bob and Carol can usually be found either on the tennis court or indulging their passion for traditional jazz, big-band, and classical music.

And still more news from the mighty 30th reunion bash. . . . **Sandy Nobel** is still in marketing and general management activities for the Harry R. Desler Corp., which sells secondary materials, such as petroleum, coke, and graphite. Sandy and Marjorie have three sons, two of whom are pursuing technical careers. Andrew, 25, received a PhD from Stanford and Gary has an SM in mechanical engineering from Berkeley and is now working at the National Bureau of Standards. Their youngest son, Philip, is an arts and science major at Cornell. . . . Among the regulars at our reunions have been Maryanne and **Bob Jones.** Currently, Bob is with MRJ, Inc., a defense systems consulting firm recently sold to Perkin-Elmer Corp. MRJ currently employees nearly 300 staff members. Bob and Maryanne have two children—Marcie, who is now at Pine Manor College in the Boston area, and Larry, who is attending school in Richmond, Va.

Bob Schwartz is now doing telecommunications consulting work for the Newhouse Publishing Group, a privately owned publishing conglomerate with some 27 companies. To handle the telecommunications activities, Newhouse has formed its own internal company called The Systems Group Corp., which has a staff of 16 employees. . . . **Conrad Revak** is in the Department of Psychology and Radiology at St. Margaret Memorial Hospital in Pittsburgh. In addition, he is at the staff at St. Francis Hospital in Pittsburgh. Conrad has published an extensive number of papers on various aspects of radiology. . . . More on the continuing saga of our classmates' travails and travels next month.—**Mike Brose,** Secretary, 841 Magdeline Dr., Madison, WI 53704

60 30th Reunion

Aaron Bloom writes, "When I saw you last at our 25th, I was running a plumbing supply business. I retired in 1987. I am now an electrical engineering student at Northeastern University. I have just completed my first co-op assignment at MITRE Corp. I look forward to seeing you in 1990." Aaron's letter is a reminder that our quinquennial get-together will be here before you know it. Keep some time open in early June.

From my West Coast reporter comes news of **Tom Heinsheimer,** balloonist extraordinaire. Tom, vice-president of Titan Systems in Redondo Beach, Calif., made aviation history by organizing the first international team to fly hot air balloons in the USSR. Tom and his team were invited to form a joint USA/USSR team to support the Soviets Mars 1994 unmanned balloon program. Perhaps Tom can write us more about ballooning in the USSR and the Mars 1994 project.

From the *New York Times* comes word that **William Morris** was named chairman and CEO of J&W Sleigman and Co., New York. Congratulations, Bill. . . . **Amedeo Pesce** writes that he has just finished co-editing a clinical text for medical technologists. Amadeo and **Ralph Bucher** are colleagues at University of Cincinnati's School of Medicine.

Milton Weiner, lead engineer at MITRE Corp., headed a 66-person U.S. delegation to Geneva, Switzerland, for a meeting of the International Consultative Committee for Telephone and Telegraph's study group on Integrated Services Digital Network Telephone Switching and Signaling. The focus of the meeting was on specifying and implementing procedures and priorities into the networks of developed and developing countries.

The April 24 edition of the European *Wall Street*

Journal featured an interview with **Li-an (Lawrence) Chen,** economics minister for the government of Taiwan. The interview emphasized prospects for the Taiwan economy with slower growth than has been the rule in the recent past and a transitioning from labor-intensive to technical-intensive industries. Before being named to the economics post, Lawrence was chairman of Taiwan's National Science Council, vice-minister of education, and deputy secretary general of the Nationalist Party.

George Siscoe has been named to the Space Studies Board of the National Research Board, the operating agency of the National Academies of Sciences and Engineering. George is a professor in UCLA's Department of Atmospheric Science. As a member of the board, he will assist in advising NASA and other agencies with space interests on long-range research strategy, earth observations, and microgravity research.—**Frank A. Tapparo,** Secretary and Class Agent, 15 S. Montague St., Arlington, VA 22204

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News for the 1962 Class notes is both happy and sad this month. We received notification that classmate **Mike Jablow** died from natural causes in Tokyo, Japan, on January 12, 1989. Mike had gone to Asia more than 20 years ago with Motorola and then was one of the founders of Nihon Teksel, a company that continues to represent many U.S. semiconductor manufacturers in Japan. On a personal note, Mike was a good friend during our student days at MIT, and I will always treasure his special friendship, kindness, helpfulness, leadership in many student activities, and his sense of humor that made it such a pleasure to be in his company. While we are diminished by his passing, the world is a better place today because he was in it for some 47 years.

George Lakoff, who received his MIT degree in mathematics and English literature (XXI B) has published a new book with co-author Mark Turner. The work is entitled: *More than Cool Reason: A Field Guide to Poetic Metaphor.* George, a professor of linguistics at the University of California, Berkeley, and his colleague from the University of Chicago, have elucidated "a postmodern *Understanding Poetry,* a new way of reading and teaching that makes poetry again important." This is just the latest of George's books on topics from poetry to philosophy and the theories of knowledge.

On the lighter side, our classmate **Oliver R. Smoot,** was featured in a news article in the June 6, 1989, *New York Times,* once again remeasuring the Harvard Bridge in its latest reincarnation. The MIT chapter of Lamda Chi Alpha has maintained the tradition for 30 years of "re-Smooting" the bridge twice each year. You may recall that we presented a commemorative plaque at our 25th reunion that will be placed on the bridge when it is once again deemed fully operational. *People* magazine featured the story of the legendary Smoot in its issue of April 24, 1989, and the article also featured Ollie's son, Stephen, who is an undergraduate student at Tech. Apparently Stephen has been more recently involved in an attempt to establish the "New Smoot" as an additional standard of measurement for the Harvard Bridge.

Theodore J. Sheskin writes that he has been on the faculty of the Industrial Engineering Department at Cleveland State University since 1974. He is a full professor of IE, and teaches courses in operations research and engineering economy. Ted spends his summers at the NASA Lewis Research Center in Cleveland, and in September 1989, he will begin an academic year of professional leave.

An article from the Pasadena, Calif., *Star-News,* dated April 24, 1989, features classmate **Ray Landis,** dean of the engineering school at Cal State, Los Angeles, encouraging students to seek careers as engineers and to "forget the business school mob." I don't know how that will sit with those of us on the faculties of business schools, but most of us did start out as engineers and scientists before we were lured into business by the color of money. Ray stresses "the select few with engineering degrees," and most of us do appreciate the laws of supply and demand as the ultimate determinant of value in our materialistic society. Ray advises students with ability to "stay with heavy academics, because it keeps your options open."

Gordon W. Mann writes that he has been with Eaton Corp. for eight years where he directs worldwide planning and product management for the Vehicle Components Group. Gordon and his wife Gail really enjoy northeast Ohio, but their life has taken a dramatic turn now that both son and daughter are away at college—they are "freer but poorer." There has always been a cost for freedom, but I must admit it hasn't always included college tuition.

Pandelis Velissaropoulos writes that he moved from Greece to Princeton, N.J., three years ago. He had been in the shipbuilding, shiprepair, and shipowning business, and owned a company involved in underwater work. He began his present work in Princeton as marketing vice-president for a company involved in solar energy (producing amorphous silicon solar electric panels). He is presently re-entering the marine business as an investor, investment advisor and technical consultant. His son, Stephanos (age 17) will be an ESU scholar in England next year while his daughter, Arianne, studies at The Lawrenceville School.

Another article from *The Houston Post* featured "Wine Talk" discusses classmate **Dave Stare** and his exploits since 1972 to bring Dry Creek Vineyards to the forefront of California winemaking. Dave relates how land was still reasonably priced in the Sonoma Valley in the early 1970s and competition was not nearly as severe. The Sonoma Valley had 35 wineries in the early 1970s and it now has 120. California had 250 wineries 30 years ago, and it now has over 700. His sailboat *Fume Blanc* is featured on many of his bottle labels. The Houston wine critic goes on to say that Dave's wines will never be listed "among Cheap Wines Without Guilt," but are an "elegant choice for the Connoisseur's Class."

Keep those cards and letters coming with your words of wisdom and remembrance.—**Hank McCarl,** Secretary, P.O. Box 352, Birmingham, AL 35201-0352

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Some time ago I reported on several long-timers who had been in one job more than a few years. So it is again. **Lew Shulman** has been running his own business as a general contractor in Elizabeth, N.J., for 14 years! He has lived in the same house 18 years. Also, **Don Dreisbach** has been teaching philosophy at Northern Michigan University 20 years. What tap roots some of us have put down. I think **Bill Zoller** has long been involved in his practice of architecture. He tells us he is now also working on a master's degree in rehabilitation counseling at the University of South Florida.

Mike Lukas, who lives in Eastlake, Ohio, is "getting involved in applying AI techniques to automating the design engineering process." Mike, let's not take on anything too easy, now! He is with a division of McDermott International called "Wisdom Systems." His son, also named Michael, "quit the technical rat race (MIS designer) to take a master of ceremonies job at Disney World/MGM Studios!" . . . **Meg Hickey,** who graduated with us as a mechanical engineer, then got another MIT degree, B.Arch. in 1969. She sent us an invitation to a one-person exhibition of her "Computer Programmed Color Works," at the Mass. College of Art back in April. The invitation itself was very pretty and colorful, a kind of Piet Mondrian-by-machine, seemingly random strokes and blocks of color which somehow make a beautiful whole. It made me wish I could have attended the exhibition.

A Tech spinoff that started a couple years ago in Cambridge, called American Superconductor, includes on its technical advisory board **Frank Fradin,** who is also associate director of the Argonne National Laboratory. That's press-release stuff, and a chance to remind you-all again: please tell me directly about your activities. It's much more personal and appropriate for classmates. . . . **Ralph Grabowski** has been quite active on the speech circuit in New England. You may recall he started a marketing consulting firm for technical products based in Andover, Mass. Ralph just spoke to the Smaller Business Association of New England on "Pricing," and on "Trend Analysis" at SBANE's annual conference.

In May, shortly before writing this column, I got a wonderful, newsy letter from **Frank Model.** A bit over two years ago Frank reported his older child, Karyn, at SUNY/Stony Brook, deciding to become an economist, while **Mike Bertin**'s daughter Amy was a senior at the 'Tute in economics. I paraphrased Frank as speculating wistfully (Frank thinks it should have been "whistfully") of Karyn and Amy at grad school together at MIT. "Well, they did even better: they are both completing their first years in the economics doctoral department at Harvard. This last sentence should evince an indignant response from chauvinistic class-mates." Damn right it does, Frank. Frank reports that Barbara and **Mike Bertin** just came back from a four-month around-the-world trip, and are about to celebrate their 25th anniversary together. How the hell does time go so fast? Frank's wife, Sue, is an assistant professor of sociology at UMass/Amherst. Since Frank still is a top research guy at a company on Long Island, this means a commuter marriage. "Believe it or not, the commuter marriage is quite endurable once the nest is empty." Have any of you had this experience, and with what results? Frank's son Daniel just finished sophomore year at Kenyon College in Ohio, and will do junior year in the UK at Exeter University.

My Julie, at writing time 10-months-old, is trying to walk and talk, but has work to do on both. Gary, 19, is getting ready to start grad school at the 'Tute. And Linda and I are still trying to combine running a start-up consulting business with running a start-up heir.—**Phil Marcus,** Secretary, 3410 Orange Grove Court, Ellicott City, MD 21043, (301) 750-0184

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It was a dark and stormy night in Cambridge, as the Class of '64 gathered at Mystery Night in Ashdown House—just one part of a fantastic 25th reunion. The weekend was put together by **Bill O'Halloran** and his committee: **Emma Root, Bruce Strauss, Gary Walpert,** and **Steve Roberts.**

More than 180 of us returned for our 25th and along with spouses and guests took part in four days of varied activities. The most notable returnee was **Richard Murray,** whose death had been erroneously reported to MIT three years ago. When Richard came into the Sunday brunch, more than a few people were pleasantly amazed. The prize for greatest terrestrial distance travelled to get to the Reunion goes to **Henrik Wessel,** who with his wife and son came to Cambridge from Norway.

At the Technology Day luncheon on the Friday of the reunion, **Bob Popadic** (reunion gift committee chair) announced our class gift, contributions and pledges to the Alumni Fund totalling $1.964 million. Although the total may increase even more due to late-arriving gifts, Bob and his 27-person committee are to be congratulated for a tough job done well. Bob was especially eloquent in his remarks on behalf of '64 at the luncheon. A big thank you to each person who contributed to help MIT continue to be the best at what it does.

What it is that MIT does was the subject of

Reunion chair Bill O'Halloran and his wife Gretchen relax at the end of the very successful Class of '64 25th reunion. The final event was a Sunday brunch at 500 Memorial Drive (which most of '64 had a hard time finding, on the ever-changing MIT campus.)

presentations and discussions on Saturday morning. Classmate **Bob Weinberg** gave a lecture on molecular biology and cancer which was both informative and "listenable." It's easy to understand why Bob has received awards and recognition for his research and his teaching.

Next, Professor Amar Bose, '52, who taught many of us in 6.01, outlined his thoughts on how MIT has changed since 1964 and what could be done to make MIT better. Professor Bose made specific suggestions concerning admissions (select only the best, regardless of . . .), faculty rewards (give teaching greater importance than publishing in promotion decisions), academic emphasis (stress science and technology, even at the expense of being a "whole university"), and the recent academic experiments such as pass/fail and the Independent Activities Period (eliminate them).

Ann Friedlaender (Ph.D., '64), Dean of the School of Humanities and Social Science, discussed the importance of a liberal education in the context of a society split between progressive and pastoral objectives. Dean Friedlaender contended that MIT does better at educating complete liberal arts students because of its technological balance than does the traditional liberal arts college, i.e., that place up the river. She argued that a liberal component of education is quite important to today's scientists and engineers because of the societal implications of technological projects such as nuclear power and the Strategic Defense Initiative. Though Dean Friedlaender and Professor Bose agree that the Independent Activities Period is an experiment that has failed, they disagree on the value of freshman pass/fail.

The presentations by Professor Bose and Dean Friedlaender, as well as the questions and answers which followed, are indicative of a high degree of creative tension in the MIT community concerning future directions for the Insitute. Should it focus on science and technology or should it be a whole university? This is a crucial question, and one which we have an opportunity to influence.

Paul Gray has indicated he is stepping down as President, and a search for his replacement is underway. The next President of MIT will play a key role in choosing the Institute's future course. Our thoughts as to what type of leader MIT needs are solicited and welcomed by the Search Committee. This theme was echoed several times during the weekend—MIT wants our ideas as well as our money.

A dinner-dance was held Saturday evening. It featured a live broadcast by Boston FM radio station WROR. Oldies from the early 60s and a lively disc jockey kept us all on the dance floor until the wee hours.

The reunion concluded with election of class officers at the Sunday brunch. Elected to five-year terms were **Bob Popadic,** president; **Bill O'Halloran** and **Emma Root,** vice-presidents; **Bruce Strauss,** treasurer; **Joe Kasper,** secretary; and **Steve Glassman,** class agent. Outgoing president **Carl Uhrmacher** received a round of applause for the five years of service he gave to '64.

In future columns I'll share some of the personal news tidbits picked up at the reunion as well as items from the notes you sent with your Alumni Fund contributions.

For those of you travelling near Dartmouth College, I am now associate director of the Design Center and director of corporate relations at Dartmouth's Thayer School of Engineering. I will also be doing some teaching. If you're close by, please stop in.—**Joe Kasper,** Secretary, RR1, Box 181, Lyme, NH 03768

65 25th Reunion

This isn't quite as short a column as last month's, but it's not going to set any records for "long." . . . **J.D. Roach** writes that he was appointed president of Manville Sales Corp. in April and is enjoying Denver and the Rocky Mountains. He's still active in running, bicycling, and snow skiing (particularly Vail, Colo.), and enjoys traveling a lot. . . . **Walt Paciorek** says he recently became laboratory manager for Durel Corp., a maker of electroluminescent lamps and a joint venture of 3M and Rogers. . . . **Chris Ebbe** recently moved from a Cucamonga condominium to the small college town of Claremont (both in the Los Angeles area).

Dennis Bekeny is still practicing pediatrics and adolescent medicine in New Haven and at the Yale University Medical School. He says he's looking forward to our 25th reunion next spring. . . . A newspaper clipping reports that **George McKinney** has left his temporary position as president of American Superconductor Corp. of Cambridge to return to his position as a managing general partner of a venture capital firm, American Research and Development. George will remain chairman of American Superconductor's board. American Superconductor is a start-up whose goal is to produce high-temperature superconducting materials in usable form. . . . **Richard Sorbello** has received an award for outstanding research and scholarship as a member of the University of Wisconsin, Milwaukee, faculty. He's a professor of physics and an expert in electromigration in metallic microstructures.

As I write this, it's late June, hot, and humid. I hope this summer won't be a "schorcher" like 1988 and that, in any case, it will be cool by the time you read this.—**Steve Lipner,** Secretary, 6 Midland Rd., Wellesley, MA 02181

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Eleanore and **Bill Klepser** report that their daughter, Cheryl, is in the class of 91 (Course 3). Eleanore has returned to school to get an MBA in accounting from the University of Buffalo. Bill has been pulling banners over the Buffalo Bills and Buffalo Bisons games. He survived a plane crash last October and is back to flying again.

Donald DeAngelis, a senior research staff member with the Environmental Sciences Division of Martin Marietta, has been appointed to the editorial board of Mathematical Biosciences. . . **Bruce Magnell** has been director of the Oceanographic Services Department for EG&G's Washington Analytical Services Center since 1986. . . . **Tom McDonough** is working on another novel, to be published next year.—**Jeff Kenton,** Secretary, 7 Hill Top Rd., Weston, MA 02193

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Kamal Meattle is director of several companies and is constituted attorney of Paharpur Cooling Towers, Ltd., of New Delhi, India, a private company that produces cooling towers, finned tube air coolers, corrugated board, flexible packaging materials, woven sacks, and perfumery chemicals. The company specializes in flexible pouch systems for packaging of lubb oils. . . . **Chuck Kolb** is a candidate for 1990 chairman of the northeastern section of the American Chemical Society. Since 1985, he has been president and chief executive officer of Aerodyne Research, Inc., in Billerica, Mass., a company he joined in 1971. Chuck has actively supported MIT over the years; he served on the board of directors of the Alumni Association from 1986 to 1988.

Dave Schramm, along with two co-authors, has published a new theory of how galaxies are formed which suggests that they may be distributed in the universe like the frosty planes inside a fractured ice cube rather than at random. The theory was published in a recent issue of *Comments on Nuclear and Particle Physics.* Dave is Louis Block Professor in Astronomy and Astrophysics at the University of Chicago. . . . **Nolan Perreira** is deputy director of the Department of Water for Maui County, Hawaii. "Water's not so simple these days," says Nolan. "THMs, PCBs, ERAs, EPAs—class 5.01 turned out useful after all, and so did Harvard Business School. I am having fun." In addition to being a staff member at Los Alamos National Laboratory, **Alan Perelson** is an

Innovative Continuing Ed in Cleveland

Members of the classes graduating in the 1960s are well represented among the instructors and organizers for an innovative continuing education seminar jointly sponsored by Cleveland area alumni/ae of MIT and the Case Institute of Technology (CIT).

The seminar, scheduled for Oct. 21, will focus on strategic planning, managing in a technological environment, and applied manufacturing technology, and will also include tours of CIT facilities devoted to design, artificial intelligence, and robotics.

Jack Kerrebrock, acting dean of engineering at MIT, and Glenn Brown, dean of engineering at CIT, will be featured speakers. Norm Klivans, '40, of Klivans, Becker and Smith, is one of the prime movers behind the event, which he says is unique in the way it utilizes local manufacturing expertise, instead of relying on professors sent out by the educational institutions represented.

Within the broad subject areas, speakers will discuss such topics as flexible personnel programs, patent protection, industrial marketing, cogeneration, process control engineering, robotics, and semiconductors.

The organizers have lined up a substantial number of industrial sponsors for the seminar, which will include presentations by MIT grads William Adams, SM'56, Wyatt Newman, PhD '88, Elizabeth Shaw, '77, Gregory Malkin, '76, and Scot Duncan, '65.

Information is available from Norm Klivans, 932-7256, and Scot Duncan, 642-5644, area 216. □

external professor at the Santa Fe Institute, a nonprofit research institute focusing on research relating to complex systems, where he leads a program in theoretical immunology, one of his primary research areas. . . . **John Howard** manages an engineering group which designs machinery to make surgical sutures and needles for American Cyanamid. He lives close enough to work to bicycle commute six months of the year. John's oldest daughter, Kathy, graduated from Boston University in 1988 and now works as a marine biologist on the New England coast. . . . Last year, **Dick Schulze** left San Diego and the private practice of law to join Hewlett-Packard's research labs in Palo Alto, Calif., where he specializes in intellectual property law. He is "having a blast."—**Jim Swanson,** Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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About 70 classmates joined with their spouses, significant others, and children to celebrate our 20th class reunion, June 8-11. At the end of Technology Day (Friday) we stuffed our faces on "heavy hors d'oeuvres" at McCormick Hall, thence to the amazingly revamped student center—now resembling a glitzy mall—where we dined and tried to relive our days of youth (at least some of us) by gyrating to the music of The Invaders. Those of you who were in Herr Dyck's "Greek Tradition" German class should know that **Richard M. Barnes, Daniel A. Briotta,** and **Stanley M. Kozubek** held a small impromptu mini-reunion right then and there. The traditional cook-out near the athletic facility was held Saturday afternoon. In the evening, many of us hopped onto the yellow school bus waiting for us at 500 Memorial Drive and traveled to the elegant Boston Harbor Hotel. While we enjoyed well-lubricated, dizzying conversation, we enjoyed a fabulous feast of continuous buffet and still more hors d'oeuvres. Oi! We gazed at the harbor lights and watched aircraft buzzing over Logan Airport. Dr. **Thomas Najarian**'s wife, Sina, entertained us with a brief piano concert—a moment of inspiration and reverie—as we all silently watched one another watching.

Class officers remained the same after the June 11th election at brunch, except that **Robert Weiner** is now president and **Ross Hunter** is vice-president—by mutual agreement, not a palace coup. **Jeffrey S. Lepes** continues as treasurer and I was re-elected class secretary.

Robert A. Schaffer writes that he is flying around the country training citizen groups on how to use the news media as part of a foundation grant. He is also co-author of Standing Up to the SAT (Simon and Shuster, 1989) and says that he is "proud that MIT has been a leader in reducing the tyranny of testing." . . . **William P. Mitchell** writes that he has completed seven interesting years working for the Commonwealth of Massachusetts as Senior Programmer/Analyst and Security Officer. He is still also doing public affairs radio at WMBR. . . . **Rexford A. Stark** reports that he is operating his own mail auction of historical American antiques. . . . **Peter Q. Harris,** M.D., has been appointed senior vice-president of patient care services of Bry-Lin Hospitals, Inc. of Buffalo, N.Y. He has assumed the position of medical director of the 180-bed private psychiatric and chemical dependency treatment hospital. . . . **Carol Scott-Conner,** M.D., is now an associate professor of surgery at the University of Mississippi Medical Center in Jackson. Before joining the faculty and surgical staff at UMC in 1986, Dr. Scott-Conner was an associate professor of surgery at Marshall University School of Medicine in Huntington, W.V. and on the surgical staff of the Veterans Administration Medical Center, St. Mary's Hospital, and Cabell Huntington Hospital in that city. Dr. Scott-Conner will be continuing her research in gastrointestinal tract surgery, biliary tract surgery, burn surgery, and breast disease surgery.

Ora Smith continues on his stellar high-technology path, moving in May from his senior position at Rockwell International in Thousand Oaks, Calif., to become vice-president and chief marketing officer of Conductus, Inc., in Sunnyvale. Conductus was formed in September 1987 to explore and commercialize high-temperature superconductor technology for use in advanced electronics. Ora currently serves on a number of committees and boards, including the Committee on Japan (part of the National Research Council), the Industrial Research Institute, the White House Science Office, the Consortium for Advanced Technical Education and the MIT Educational Council. He is also a member of the bar in Massachusetts, Washington, D.C., and California, and with several federal courts. And once upon a time he was a new arrival on Burton 4th from Caruthersville in Missouri's panhandle. (I bet most of you didn't know that the "show me state" had a panhandle!)

Friends, that's all. Just keep those notes flowing. (The really perceptive will wonder why the zipcode of Bow, N.H., has changed from 03301 to 03304. Bow, pushing 5,000, is finally big enough to step out of Concord's shadow.)—**Eugene F. Mallove,** Secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

70 20th Reunion

Wesley F. Moore is upset with the way I edit his communications into "meaningless one-liners." Therefore, we have printed verbatim his notes as sent to the Class Secretary: "With a little help from me on pre-med physics, spouse Sandra (Radcliffe '70) will be entering University of Washington Medical School this fall. Thank heavens for the microwave! William (5), and Amelia (8) continue with their full-blown childhoods. The new cat has already finished with his. I considered having a mid-life crisis this year, but was unable to fit it in. We will (by the time you read this) have driven Seattle/Florida/Seattle in a 10-year-old station wagon—the only way to convince the kids that it *really is a long* way to grandma's house."

Raymond Kurzweil has delivered the commencement address to College Misericordia's 1989 graduates. . . . **Stuart Marson,** after graduating from MIT, received a doctorate in chemistry at Stanford University. He did a National Institutes of Health postdoctoral fellow at Berkeley in chemistry, concentrating on the use of computers to solve chemical problems. Thereafter, he started a company with several other associates using computers to do conformational instructural analyses to effectively design new chemical entities. The company was formed in 1978 under the name of Molecular Design Limited, with four employees. They continued to develop software products until the company in 1988 had sales in excess of $20 million. In 1989, he received the America Chemical Society's Herman Skolnik Award for his outstanding contributions to the theory and practice of chemical information science. Part of the benefits of his dream of helping chemists in their pursuit of chemistry involved saving his niece, who was lying in a coma close to death. A pharmaceutical company, who had been a customer of Molecular Design Limited for a number of years and used his software, had developed a drug that saved her life and she is now completely cured. He has a strong belief that his products directly contributed to the saving of his niece's life.

Melinda Bird received her law degree from Rutgers University School of Law in 1978 and commenced working for West Virginia Legal Services Plan. Since that time, she has been involved in poverty and welfare law and was awarded the Public Council Award for her work in the public interest. She is presently employed at the Western Center on Law and Poverty in Sacramento, Calif. She has argued numerous cases before the Trial and Appellate Courts of the State of California, focusing upon the legal rights of poor families, the homeless and mental health patients. She is married to Peter Schey and has one child.—**Robert Vegeler,** Secretary, Beers, Mallers, Bachs, Salin, & Larmore, 2200 Ft. Wayne Ntl. Bank Bldg., Ft. Wayne, IN 46802

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I ran into **Chris Brewster** and his wife Marianna in New York outside a hotel at 11:30 pm. Since we both live in Texas, we were surprised to see each other in the big city. I also had a nice visit with Drew Jaglon, '74, and his wife Janet and their children in their beautiful home in Bronxsville. . . . **Adrian Bejan** was awarded the J.A. Jones Chair in Mechanical Engineering at Duke University. **Richard J. Hawryluk** is a recipient of

the American Physical Society's Division of Plasma Physics Award for Excellence in Plasma Physics Research. The citation reads: "For the Discovery and Scientific Exploration of Enhanced Confinement Plasmas with Ion Temperatures in excess of 20keV in the Tokanak Fusion Test Reactor.

Mark F. Roddin writes: "I've recently completed a 30 year San Francisco Bay Area Seaport Plan covering four public, two private, and one future ports. Now I'll be turning my activities to the Regional Airport Plan. My wife Barbi had a baby girl last fall (four days after her 40th birthday) so we now have a boy, Craig, and a girl, Alicia. . . . Dr. **Raisa B. Deber,** associate professor at the Department of Health Administration of Toronto, writes: "In addition to our normal academic activities, Charles and I found ourselves receiving notoriety for our extracurricular lives. Charles had several interviews about his crossword constructing, while Raisa was a two-time winner on Jeopardy (just missing on show three for not knowing that South Korea was not in the U.N.). Charles is a professor at the Department of Biochemistry at the University of Toronto. Please keep those cards and letters coming in.—**Hal Moorman,** Secretary, P.O. Box 1808, Brenham, TX 77833

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Not a great deal of new stuff this month, but at least one honor to a classmate; **Cherry Murray** was named recipient of the 1989 Maria Goeppert-Mayer Award, as reported by the American Physical Society. Her citation was for "the elegant and direct experimental methods she used to discover two-stage melting in two-dimensional arrays of polystyrene spheres." Congratulations to Cherry. . . . **John Clippinger** is teaching at Beaver Country Day School and is a Macintosh consultant on the side.

Peter Fleischmann left ADP after 15 years with them to join a small Long Island software company, Attorney's Data Systems, as president. Wife Susan is expecting a second child in July to join son Matthew ('07) in their Manhattan home, though a move to the 'burbs appears imminent. . . . **Kenneth Mayland** was written up in the Akron *Beacon-Journal* for his combination of a serious fishing pastime and his new job as chief economist for Cleveland's Society Corp. after eight years in a similar role at First Pennsylvania Bank in Philadelphia.

The family is off for the summer now, spending many hours poolside and watching the kids in their summer forays into organized baseball. Eric ('96), recently turned 15, and begins his sophomore year at Fauquier High in the fall. JR ('03) starts third grade at the same time. Yours truly got to sing with Victor Borge this past week in a Wolf Trap show to be broadcast over PBS, perhaps after this is published. The show honored Borge on his 80th birthday, and featured the Alexandria Harmonizers, who may or may not be the International Chorus Champions when this comes out. Clearly, you'll know next issue. Write!—**Robert M.O. Sutton, Sr.,** Secretary, "Chapel Hill", 1302 Churchill Ct., Marshall, VA 22115

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Our 15th Reunion was a fine time, populated by people who mostly didn't know each other, but enthusiastically warmed to the occasion. In addition, there were children in attendance, some as old as 10, and a little one barely 14 days old making her first public appearance. The new class officers are president **Sandy Yulke,** vice-president **Ed Hanley,** treasurer **Marty Davidoff,** secretary **Lionel Goulet,** class agent **David Shiang,** and members-at-large **Paul Mailman** and **Steve Bates**—no surprises. Many thanks to Steve Bates for making the reunion fun and flawless. We passed a notebook around during the reunion's Saturday night dinner at the Science Museum, and there's news in it from every attendee. That news will appear in the next few columns, so if you were at the reunion and don't see your name here, please hang on.

A long letter from **Richard Sternberg** comes via **David Shiang.** Dr. Sternberg is very busy in his own orthopaedic practice in Sterling, Va. He's looking for an associate, but "good help is hard to find." Rich and Kim Redler were married in September 1986, and two years later, "were blessed with a baby girl, Marissa. Unlike anything else I have ever done in my life, she was early. We were on vacation in Hershey, Pa. Kim went into labor in Chocolate World, and Marissa was born soon after. A couple of days later we made a nice, slow drive back down to Northern Virginia." . . . **David Shiang,** class agent and owner of the world's largest Firesign Theatre record collection, works at Harbridge House, a management consulting firm in Boston. . . . According to a NASA press release, **Woodrow Whitlow** is 1989 Black Engineer of the Year for Outstanding Achievement in Government. Dr. Whitlow, who received his bachelor's and master's at MIT, was also MIT's first Black American recipient of a doctoral degree in aeronautics and astronautics. He is a volunteer tutor in local high schools and colleges, and he helped establish an Institute for Minorities for youth interested in science and engineering careers, teaching 6th, 7th, and 8th graders on Saturdays at Old Dominion University. His research in computationally unsteady fluid dynamics is internationally known.

Vincent Leung of Stockton, Calif., was inducted in February as a fellow of the American Academy of Orthopaedic Surgeons. . . . **Douglas Looze** is associate professor of electrical engineering at the University of Massachusetts, Amherst. . . . **Wayne Stargardt** has been appointed vice president, software engineering, of Harris Data Communications in Dallas. . . . Susan and **Steve Jordan** welcomed Katherine Howland Jordan into the world May 10. The Jordans hail from Los Altos Hills, Calif. . . . **Edward Montes** is district manager of technical support for Relational Technology, of Rockville, Md. . . . **Michael Tuts** is associate professor of physics at Columbia University. He and his wife, Alice, live in Manhattan.

Jan and **John R. Black** live and work in Pittsburgh, though they spend a lot of time in Brazil working with Alcoa's plants there. John says that despite the time spent in Brazil, his Portuguese is still awful. . . . Doing a bit of travel too is **Manuel Malagon,** executive officer of the U.S.S. Puffer, a nuclear-powered attack submarine based in San Diego, Calif. . . . The travel award, though, goes to **John E. Plum,** who relocated to Tokyo in January. His whole family is learning Japanese and how to get around the city. John has taken charge of institutional sales and capital markets for Citicorp. "Mimi, Sabrina, and Tamina are fine. We welcome any visitors."

Here is the first MIT Fun Fact—something good you probably didn't know about MIT (readers are welcome to contribute their own): Companies started by MIT graduates account for $10 billion in annual income and 300,000 jobs for Massachusetts residents.—**Lionel Goulet,** Secretary, 115 Albemarle Rd., Waltham, MA 02154, (617) 899-9694

75 15th Reunion

Jeffrey L. Star emphatically anounces (if I could reproduce all his underlinings and exclamation points I would) that "the textbook is *done,'' Geographic Information Systems: An Introduction,* Prentice Hall, Summer 1989. Congratulations on what was no doubt a major undertaking. . . . **David I. Katz** writes, "Still living in Pennsylvania and working in Princeton. We like the area northeast of Philly, but seeing the farms turn into fields of condos is a little sad. Karen continues to sell Discovery Toys and is starting a used-computer brokerage in this area. Our sons, Robert, 7, and Daniel, 5, are in day-camp this summer."

Mike Kozinetz writes, "We have moved back closer to the Northeast—to the Beaver Valley area near Pittsburgh. I am still working for John Brown E&C, and we are constructing an industrial plant in the area." He and wife, Michelle, are enjoying living in the area and, at the time of writing, were looking forward to the upcoming golf season there. . . . From the *New York Times,* I've learned that **Robert W. Mann, Jr.** is now vice-president of marketing for Trans World Airlines, Inc., located in New York City.

A delightful article in the *Dallas Morning News* (April 22, 1989) features Leigh and Justin Notestein, daughter and son of **David Notestein.** The siblings were about to compete in their local school district's "invention convention." Leigh had built an alarm that buzzes if the refrigerator door is left open for more than a few minutes, and Justin had invented a device that keeps long extension cords from becoming tangled. It looks like the acorns have not fallen far from the tree, since classmate David, himself, has patented a material-testing device. David is now a senior vice-president of an insurance company in Dallas. It sounds like the Notesteins are a true "mens et manus" kind of family. Best of luck with all that inventing—and don't forget, the patent bar is well represented in the class of '75.

That's all for now. Keep writing.—**Jennifer Gordon,** Secretary, c/o Pennis & Edmonds, 1155 Ave. of the Americas, New York, NY 10036

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David Leighton reports: "Moving into a new house in March. Presented paper at SPIE Symposia on Aerospace Sensing in Orlando, Fla.: 'Synchronization and Fault Tolerance in a Distributed Tracker,' an outgrowth of work on advanced onboard signal processor. Have worked on this program for six of my eight years at Aerojet. Was accompanied by my family and had a ball at Disneyland and Epcot." . . . **Tom Downey** is "in marketing at BBN Advanced Computers and am hardware product manager for the Butterfly computer family. Still working away at fixing up our old house—a lifelong job." . . . **Jules Morris** is patent counsel for the Foxboro Co. of Foxboro, Mass. He and his wife, Leticia, live in Brookline. . . . Bernice and **Jack Mandelbaum** expected their first child last summer. Jack completed a PhD in business administration at Boston University in May 1988 and now manages strategic planning for the network and communication group at DEC. . . . **Alan Levin** works at Softbridge. He writes, "Have shifted personal focus to sales of our systems and service to financial services industry. April (7) and Todd (4) continue to be a pleasure for Marla and me. They do have their moments, though!" . . . **Ira Gerson,** a member of the Motorola technical staff, has been named a Dan Noble Fellow at Motorola. This is the highest honorary award an engineer or scientist can receive at Motorola. The award recognizes technical creativity, innovative ability, and productive achievements, and is given to those technologists at Motorola who have significantly contributed to the company. Ira was one of six selected this year. . . . **Karen (Jones) Richards** writes, "I've been married to Skip Richards, '75, for 13 years and we have two daughters—Sarah (9) and Lisa (2). We've lived in the Westboro, Mass., area since graduation. I worked in software development for about 11 years, nine at Data General and two at Prime Computer. Now I work at home, on the Mommy track. . . . At Prime I worked with **Jerry Kazin.** Jerry is married and has two sons, Ari and Zachary. Jerry is a selection manager/principal engineer in operating systems software development."

Lt. Commander **Bob Struth** writes, "I am stationed at the Grumman Facility at Calverton,

Long Island, N.Y., where we are about two-thirds of the way through the F-14D development program. It's a great airplane that is urgently needed by the Navy. Unfortunately, some politicians in Congress don't realize its importance and are trying to cut new production. My best news is that I've remarried. Korrine was widowed (as I was) and has a son, Mathew (2). With my six year old, Bobby, we now have a great family and life is better than ever! God has smiled upon us and has given us a second chance. I have been selected by the Navy as a candidate mission specialist for the space shuttle. We await NASA's decision. Failing that, we will be transferred in the spring to Washington, D.C., where I will work in the Space and Naval Warfare Systems Command as program manager for all the Navy's communications satellites. Right about then I hope to be selected for promotion to Commander. Unfortunately, I'll be flying a desk for three years, but it's about time for that career-wise. I love flying the F-14, especially the new one with its bigger engines—so after the DC job I'll definitely try for another flying assignment.

As for your secretary, the foreign exchange markets have been giving me sleepless nights, with promises of more of the same: I trade with the Far East and London at night. Our PC-based voice recognition product, the Voicebox, is slowly moving ahead. I have been contacted by some venture capital people, and am working on putting a deal together. This is quite a switch from running an international futures brokerage firm. However, the futures industry has given me the capacity to handle all types of business headaches. One great plus to the Voicebox, aside from the technology—the lack of competition. That is a novel switch, given the ferocious competition in the futures markets. Please write, fax, or call. We always need news.—**Arthur J. Carp,** Secretary, Stalco Futures, Inc., 254 West 35th St., 16th Floor, New York, NY 10001, (212) 736-1960, fax: (212) 736-3664

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In our last episode, hundreds of people just like you opened their copies of *Tech Review* to the class notes section, checked first the column of the class of 1977 and found (*Gasp!*) nothing! "%?(*!)&" you cursed, "this is unforgiveable! That good-for-nothing secretary had better have a good excuse for not reporting all the on-goings of me and my classmates." "Me? Did I say me?" you ask. "Why, I haven't written to the class secretary in years (if at all)! Why, maybe it's because I haven't provided any information that no class notes appeared!" Stricken with this sudden realization, hundreds of people rushed to their word-processors, typewriters, and inkwells to dash off a quick note to their class secretary so that never again would the class of 1977 notes be missing.

George Goodman of Albany, N.Y., has joined the GE Research and Development Center as a control systems engineer. Immediately before joining the center, he was a project engineer at Aspen Systems in Marlborough, Mass. . . . The board of directors of Freese and Nichols, Inc., a firm of consulting engineers in Texas, proudly announced the election of **Thomas C. Gooch** as a new principal. He has been with the firm for eight years managing a wide range of water-related projects. He is currently the assistant manager of the Water Resource Planning Department.

Margaret Hvatum was to have been a candidate for election to the planning board in the town of Sharon, Mass. She is an independent computer consultant and also is licensed by the state in two areas of asbestos control. The election was slated for May 2, and we hope she will let us know of the outcome. . . . **Stephen Keith,** now a lieutenant commander in the Navy, is currently the chief engineer aboard the *U.S.S. Arkansas,* a nuclear-powered cruiser. The ship was to be in overhaul at the Puget Sound Navel Shipyard until the middle of the year and was then scheduled to return to its home port of Alameda, Calif. Stephen invites anyone who happens to be in the Northwest to feel free to give him a call.

Beth Gannister says "hi" to all. Her baby is growing rapidly; the office/house addition is finally complete; and the business is doing well. She is busy converting a church into elderly housing, doing house additions, doctors' offices and more state work. . . . **Howard Boles** is working at Technical Data International writing financial software for a portfolio management system. His wife, Lisa, and daughter, Bethany, now 3, are doing fine. He actually finds time to do some theatrical music direction, having recently served as vocal director for "Whiskey Business," the Hasty Pudding production at Harvard. His newest instrument is the xylophone, and he is still active on the piano and the French horn. They still live in Marlborough, Mass., where they stay in touch with former roommate Channing Lai, '75, and his wife, Lorraine, who recently had a baby boy.

Sergio Cabrera is an assistant professor of electrical enigneering at Penn State. . . . **Jed Fuhrman** recently changed jobs and is now associate professor of marine biology at University of Southern California. He and his wife, Dorothy Comeau, '79, had their first child, Gabriel Aaron, in December. He reports, ". . .scored Apgar 9 at birth! Clearly tests well. . . . " They are enjoying sunny southern California and invite their friends to look them up. . . .**David Batchelor** has joined the staff of NASA/Goddard Space Flight Center in Maryland. He works for the National Space Science Data Center . . . **Glenn Tuckman** is married and has two children. He works at Reading Hospital as an MRI/CT/VIS specialist in the Radiology Department, as well as practicing as a general radiologist.

Scott Moor spent last year in Canada teaching a chemical engineering class at the University of British Columbia and developing a new engineering program at Simon-Fraser. He is now back in the San Francisco Bay area teaching at San Francisco State and Canada College. . . . Another recent arrival in California is **David Outzs,** who just moved to San Diego and is enjoying the sun and renovating an old house. He is still working for Hewlett-Packard as a senior systems engineer. . . . **Paul Menard** is in Carmichael, Calif., and is still vice-president of PC/M Group, Inc. They performed $3.2 million of architecture and construction services in fiscal 1988-89.—**Ninamarie Maragioglio,** Secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153

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This column brings our first installment of "Electronic Class Notes" via Assistant Secretary for Networks **Julie Kozaczka Stahlhut.** Julie is compiling an electronic address list, and we urge all of you Internet/Bitnet/Compuserve users to send your address (and your news) to her. Julie tells us she is getting into networks big-time, as she is "about to become the junior half of the brand-new Network Planning and Services group at the Harvard Medical Information Services Department."

Other networkers send news. **David Woodruff** has been with the MIT Industrial Liaison Program for four years and is now director of Far East Corporate Relations. His responsibilities include overseeing MIT's Tokyo Office as well as corporate interactions with all Far Eastern countries. David is living in Danvers, Mass., with his wife, Denise, and their daughter, Natalie. . . . **Bill Kath** is living in Evanston, Ill., and is an associate professor of engineering sciences and applied mathematics at the Technological Institute at Northwestern University.

Kathy Hardis writes, "Before I became a mommy, I did database management programming for the Environmental Epidemiology Branch of the National Cancer Institute (try saying that fast

three times!). Now, however, I'm a mommy to two little girls, (ages 2 and 4). In my free (ha!) time, I've been resident scientist for a civic activist group concerned with local environmental problems and have taken up quilting (using our Macintosh for the Computer-Aided-Quilt-Design, of course). We're outside of Washington, D.C., in the Maryland suburb of Rockville." (Quiltmaking has also become **Diane Curtis**'s latest interest. The computer certainly lends itself to quilt design, since the quilt in its simplest and most traditional form is a matrix of identical or similar square cells rotated to form larger patterns. While your class secretary was intrigued by the challenge of writing software for quilt design, Diane, with her customary voice of reason, suggested that the market might be somewhat limited.)

We heard from other classmates by more traditional postal avenues. **Jeff Stein** writes, "I am finally starting my last year of residency as a fellow in Vascular Surgery at Mount Sinai Medical Center in New York City." . . . **Heather Hazard** writes, "My husband, Christian Erik Kampmann, and I were blessed with the arrival of Alexandra Hazard Kampmann on November 17. Super-alert, laughing, and active, she is a tremendous source of joy in our lives." Heather has just accepted a reappointment at Harvard Business School as a postdoctoral fellow. Heather and family are living in Ipswich, Mass. . . . **Matt Lief** and wife, Sue, announced the birth of their first child, Meagan Joy, born on May 23. The Lieffs are living in Cheltenham, Pa.

From an article in the *Indianapolis News*, we learn that **Katherine Lyon** left a management post at Cummins Engine Co. in Columbus to become deputy director for development at the Indiana Department of Highways. She will oversee state highway projects from concept to competitive bid. Katherine received her MBA from Harvard after graduating from the 'Tute. We wish her well in her new post.

Your intrepid rower-secretary has had his bid for the national rowing team cut short. The competition in Boston was quite stiff this spring, with six of nine teammates receiving invitations to the national team camp. While it was disappointing to not go farther in the racing progression, it was rewarding to row in such a competitive environment (with a bunch of mostly-youngsters in their early-to mid-twenties). Further rowing activities will center on participation in some summer and fall regattas in the single.

With more free time and energy, your secretary is now pushing forward with consulting work and exploring the wonders of zymology through a class in the brewing of beer. The lab work is the best part. (Any other zymologists out there?)

And of course, free time means more time to write class notes! Send your news *today*!—**Jim Bidigare,** Secretary, 659 Green St., Cambridge, MA 02139; **Julie Kozaczka Stahlhut,** Assistant Secretary for Networks, Internet; jstahlhu@hstbme.mit.edu; Compuserve: Julie K. Stahlhut 76566,1012

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Here's your roving reporter, just back from our 10th reunion. As you have already figured out, I have been reelected your class secretary for another five years. (Thank you all for your support!) As for our other officers, they are: **Bruce Bornstein,** president; **Bonnie Mason,** vice-president; **Lisa Bendixen,** treasurer; **Brenda Hambleton** and **David Soule,** members-at-large; and **Rick Kovalcik** remains our class agent. On behalf of our class, I would like to thank Lisa, Rick, Bonnie, Brenda, **Bill Rust,** and any other members of the reunion committee whom I have forgotten, for their superb efforts in making this reunion as varied and enjoyable as it was!

The class of '79 events began Friday evening, June 9, with a roller skating party at the athletic center. Italian food was the fare of the evening, and the class of '84 partook as well. Saturday morning brought a luncheon cruise in Boston harbor. Although the weather was a little brisk (it was actually 40 degrees cooler than our last reunion, which took place during a heat wave!), those of us weak-blooded souls who never ventured from the cabin had fun anyway. On Saturday night, a dinner dance at the Royal Sonesta Hotel featured a band made up entirely of MIT alumni! The weather for Sunday morning's brunch at the new Marriott in Kendall Square was nice enough for us to eat outdoors (although every now and again a gust of wind would blow over a table!).

As may be expected, I gathered lots of dirt, some of it about people who weren't even there. First, the attendees. I've alphabetized them to make it easier for you to find your friends listed. . . . **Steven Bauer** is a partner in the new Boston office of the Chicago-based law firm of Allegretti and Witcoff, doing patent law. Steven got his law degree from Boston University, where he also teaches patent law and computer law in the evening. Steven, his wife Sarah Moynihan (also an attorney), and their Siberian husky Baka live on Beacon Hill. . . . **Lisa Bendixen** lives in Wayland, Mass., and is still with Arthur D. Little. Her husband, Jon Leehey, '78, is director of engineering for Torque Systems. . . . **Jeff Bloch** lives in Los Alamos, N.M., and is a postdoc in astrophysics at—you guessed it—Los Alamos National Laboratory. In his leisure time, he has started rock climbing ("that's the thing to do in Los Alamos!") and flying sail planes (he has a pilot's license).

Bruce Bornstein and wife Wendy bought along 5-month-old Gregory to the reunion. Bruce is an instructor at Harvard Medical School in radiation oncology, spending most of his time at the Dana Farber Cancer Institute. He is doing research on hyperthermia as a treatment for tumors. Wendy got her M.B.A. from Boston University last year and now is a financial analyst for McCormick and Dodge in Natick. The Bornsteins live in Dover, Mass. . . . **Greg Bosch** lives in Olathe, Kans., near Kansas City. He got his Ph.D. in chemistry from Cornell in 1987 and is an organic synthesis chemist for Chemsyn Science Laboratories. Greg and wife Lisa, also a chemist, left their 5-year-old and 2-year-old at home, but they did bring with them the youngest person at our reunion—4-week-old Anna! . . . **Suzanne Burzyk** is still at Poloroid and is currently chief mechanical engineer for the Norwood plant. She lives in Wellesley with husband **Dave Boccuti,** who made himself so scarce at the reunion that I never got to talk to him. Shame on you, Dave! . . . **Harvey Cohn** has lived here in Manhattan since 1985, but has only been with the firm of Richard Dattner Architects for a few weeks. Since graduation, he has lived in Dallas and San Francisco, traveled extensively in Europe, and got his master of architecture degree from the University of Michigan. . . . **Pete Dreher** told me so many fabulous lies about other classmates that I don't even believe what he said about his own activities! Suffice it to say that he was there.

Steve Feldman, who graduated with me from The Wharton School in 1981, lives and works in Framingham, Mass. He has been with Bose Corp. for the last two years and is manager of sales and marketing systems in the MIS department. Steve's name is seen frequently in the *Review* puzzles column, for which he regularly provides solutions. Steve's wife Debbie works with **Rick Kovalcik** in customer support at Stratus Computer. Rick and his wife Susan Mozzicato live in Waltham. Susan works in Boston doing technical support for Du Pont. . . . **Henry Fiorentini** and his wife Diana Carpenter (Harvard, '79) achieved true economies of scale during the reunion: her 10-year reunion took place during the same weekend! Henry and Diana live in Des Plaines, Ill., outside of Chicago. He is "an independent microcomputer software developer/consultant working with manufacturing and accounting systems. Diana is a management consultant for the MAC Group. On the leisure front, both Henry and Diana have their pilot's licenses, and they recently purchased vacation property in Wisconsin.

Michael Fischbein left NASA two months ago and is doing custom software development for Sun Microsystems in Albany, N.Y. He lives in the town of Ballston Lake, halfway between Albany and Saratoga. . . . **Cindy Frey** lives in the Georgetown section of our nation's Capitol and works in Vienna, Vir., for the National Rural Utilities Cooperative Finance Corp. Their business is financing rural utilities, and she is in charge of their medium-term note program. Her volunteer work includes recording for the blind and telecommunications for the deaf. She is also planning to work for a Ph.D. in finance, to go alongside her M.B.A. from University of Southern California. . . . **Mimi Fuhrman Kaleas** and husband Telis brought along 5-month-old Leftheris ("Terry"). Mimi was teaching science in high school in New Jersey until the baby was born. Telis works for Bell Labs in Holmdel, N.J., and they live in Piscataway.

Walter Grossman lives in Mt. Kisco, N.Y., and is an electrical engineer at Loral Electronics in Yonkers. He and wife Vered, an art teacher, brought along their 4-month-old daughter Yarden (class of 2011, claims Walter). Walter got his master's degree in electrical engineering at Polytechnic University, and is studying towards a Ph.D. "He is an A student," claims his wife! . . .**Norm Guivens** lives in Braintree, Mass., and works in Lexington as a systems engineer for Sparta, a manufacturer of tunable lasers. He has also been speaking at electronic imaging conferences. . . . **Gordon Haff** lives and works in Westboro, Mass., where he is a product manager for Data General.

Brenda Hambleton, husband **John Hopper,** and their 16-month-old twin daughters are living happily in Pepperell, Mass. . . . **Dave Heller** lives in Seattle and started his own law practice in February. Dave and wife Andrea Darvas, also an attorney, are the parents of 3-year-old twins, Thomas and Elizabeth. . . . I missed **Ed Tarney** at the reunion, but since he is so adept at gathering dirt on classmates, Dave got him to promise—in front of witnesses!—to write to me every three months with the latest news. Got that, Ed? . . . I also missed **Joel West,** but rumor has it that he would like to be the unofficial West Coast correspondent. Joe, I'll be glad to include anything you care to pass on.

Scott Kukshtel lives in Atkinson, N.H., and commutes to Cambridge every day for his job in software development with Lotus Corp. He is working on the presentation manager version of 1-2-3. Scott's wife, Yvonne Tsai, '78, practices ophthalmology. They are the proud owners of an Alaskan malamute named McKinley. . . . **Paul Lones** and **Audrey Greenhill Lones** live in North Yarmouth, Maine (15 miles from Portland). Paul is director of operations for National Semiconductors, while Audrey is a planning supervisor at Bath Iron Works. They have their own sailboat and can be frequently found sailing off the coast of Maine during the months of May through November. During the rest of the year, they ski and work on their old house, which has come a long way in the last seven years. . . . **Catherine McCammon** lives in Vancouver, is an assistant professor in Geophysics at the University of British Columbia, and is married to a professional mountain climber.

Out in Los Altos, Calif., **Anne Michon Westbrook** is starting another company. She left Software Publishing a few years ago and started a seven-person firm, which unfortunately coincided with the October 19 stock market crash. Undeterred, she is trying once again, along with John Page, who previously founded Software Publishing. Her new company will involve microcomputer software. Anne's husband, Scott Westbrook, '78, works for DEC. Anne sends out an all points bulletin to **Paul Stipe:** "Where are you?" . . . **Michael Osofsky** lives in College Park, Md., and has worked as a physicist at the Naval Research Laboratory in Washington, D.C., for a year and a-half. His field is superconductivity. He also spent a year there as a postdoc. Accompany

ing him at the reunion was his fiancee, Phyllis Reinstein, who works at the University of Maryland. An August 13 wedding was planned. . . . **Todd Peltzer,** still in the Navy after 10 years, was expecting a promotion to lieutenant commander in July. A deep sea diver by occupation, he just completed a three-year full-time program at MIT that resulted in a naval engineer's degree and an SM in mechanical engineering. He will now be returning to his home in Pearl Harbor, much to the mutual relief of Todd and his wife Sandy. Luckily, Sandy is a flight attendant for Aloha Airlines, which made a commuting marriage feasible for the last three years.

Rob Phipps lives and works in Rochester, N.Y., as a software manager for Kodak in Image Management Systems. Rob and wife Dorothy have three children: 7-year-old James, 2-year-old Robyn , and 5-month-old Jonathan. . . . **Jennifer Pieszak** lives in Brookline, Mass., and is currently a full-time mother to 2-year-old Cecily and 7-month-old Nick. Previously, she was an associate at William Lamb Associates, architectural lighting consultants. . . . **Fran Savoia Brown** lives in Reading, Mass., with her husband Doug Brown, '75, a venture capital investor, and their two children. Daughter Megan is 3 years old, and son Alex is 14 months. Fran works as an independent consultant designing and marketing water treatment equipment. . . . **Mark Schwartz** and wife Sharon brought 7-year-old Matthew and 4-year-old Rebecca along to the reunion.

Ted Senator raced a 40-foot yacht from Annapolis, Md., to Newport, R.I., and arrived in time for the reunion! He works for the Navy in Annapolis in artificial intelligence, and has his own 22-foot sailboat. He invites all classmates who are passing through Annapolis to look him up, and he'll take them sailing. . . . **Joan Sienkiewicz** is still with Electric Boat and is still commuting regularly between her two offices in Groton, Conn., and Washington, D.C. She is proud to have accumulated 189,000 frequent flyer miles on US Air since October 1987! . . . **Dave Soule** bought a house in Verona, N.J., near Montclair. He is still working at American Cyanamid. His leisure time finds him racing sailboats at the Manhattan Yacht Club. . . . **Bob Stall** and his wife Robin showed up without their 7-month-old twins. (Twins seem to run in our class—this is the third set I've heard of. Any more out there?) Bob practices internal medicine in Buffalo, N.Y., with an interest in geriatrics. He will be medical director at a nursing home this year and would like to develop a geriatric consulting practice. Robin is a certified ophthalmic technician. Bob puts out an all points bulletin on the following New House V residents: **Rae McLellan, Dave Goddeau, John Bridgeman, Dave D. Miller, Pete Bonee, Rob Yriart, Jim McCormack, Hiroshi Yoneyama,** and **Andy Sachere.** Hey guys, drop me a line—for Bob's sake!

Well, those are all of the people that I had the pleasure to chat with. Next month, I'll tell you all of the hearsay. Who knows, maybe you'll see your name mentioned! Until then—**Sharon Lowenheim,** Secretary, 500 E. 63 St., Apt. 18B, New York, NY 10021

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We received a lot of notes this month from people who took time to write down what they are doing when sending in their donations to MIT. **Scott Leonard** writes from Detroit, where he works on General Motors' corporate marketing and product planning staff. Scott is busy planning GM's sporty and luxury cars of the future. In his spare time, Scott has taken up the sport of boardsailing. . . . **Robert Cox** is now working in chemical vapor deposition applications engineering for Applied Materials in Santa Clara, Calif. Before that, Robert was working as a process engineer for VLSI Standards in Mountain View. . . . **Thomas Greene** writes that he has a new job as manager of the IBM engineering group for Cadre Technology in Providence. . . . **Thomas Grycewicz** is enjoying teaching electrical engineering for the Air Force Academy. Tom was recently in a bike accident and is just getting over a concussion. He looks forward to advising the academy scuba club next year.

Rosalinda Hernandez writes from Cambridge where she is teaching math and science to grades 6, 7, and 8 in the Agassiz public school. Rosalinda decided that the only way to really have an impact on the education of kids is to teach. Next month we'll find out whether Rosalinda makes her kids take a tutored test if they score less than 70 on any exam. . . . **Bob McGreevy** writes from Austin, Texas, where he is finishing up a PhD in chemical engineering. Bob returned from Japan in 1984 to go to the University of Texas at Austin. He just accepted a job to work for Monsanto in Springfield, Mass. . . . **Anne Marie Casavant** is now back in Cambridge, as a doctoral student at the Harvard Graduate School of Education. She is studying interactive educational technologies, and plans to get involved with developing natural history programming for television.

David Trop writes that he rowed in the Greek trireme, in Poros, Greece. David says that he thought rowing an eight was tough until he tried rowing a "170." He has also been learning to play the fiddle and added to the instrument rating on his pilot's license—but hopefully not both at the same time. . . . **Yueh Chuang** writes that he finished up an MS in the Department of Hydrology and Water Resources at the University of Arizona last fall. After a fun-filled tour of Taiwan, Yueh joined SAIC in San Diego, as an engineer/hydrologist in waste management. . . . **Adam Zilinskas** is now working for Data—I/O Redmond, Wash. Adam lives in Bellevue, and says he enjoys walking through the weeds in the Pacific Northwest.

This month we feature several celebrities that are in the news. The first is **Dale Buralli.** Dale was written up in the *Phillipsburg* (N.J.) *Free Press* as he has just published an article on holographic kinoforms in the journal *Applied Optics.* Dale is currently a doctoral student at the University of Rochester's Institute of Optics. . . . Two of our classmates were recently honored with NSF postdoctoral fellowships in mathematical sciences. **Edward Letzter,** who did his doctoral work at the University of Washington, will do his postdoctoral work at the University of Utah. . . . **Garrett Stuck,** who did his doctoral work at the University of Chicago, will do his post-doctoral work at the University of Maryland and at UC Berkeley.

As for me it's one year of business school down, one year to go. I'm back at TA Associates for the summer, and anxiously awaiting your cards and letters. Lastly, I'd like to say that I stopped by the Class of '84 5th reunion to see if they still knew how to party. They do.—**Jonathan Goldstein,** Secretary, 2 Soldiers Field Park, #201, Boston, MA 02163

84

Well I guess I was wrong—last time wasn't the last column for me to write. But this time is because we had our class reunion in June and have voted in a new secretary, **Howard Rubenstein.** Let me say welcome—I think that it will be nice to have some fresh insight in this column! Howard sent in this news after the reunion.

"Our fifth reunion was held this weekend. Fun was had by all in attendance and there was plenty of opportunity to catch up on old and new times. We (re)elected class officers: **Diane Peterson,** president; **Michael Battat,** vice-president; **Sarah Tabler,** treasurer; and **Natalie Lorenz,** class agent.

"The news for this edition was sent to the previous secretary, so I'll just add a few (marriage) tidbits. **Carmen Fernandez** was married in Puerto Rico in May. The grapevine says **Andy Dahl** will be married soon. **Dennis Sacha** will be marrying Denise Nierinckx, '87, in December.

"Please write me with news. I am on electronic mail at:hbr@wheaties.ai.mit.edu. If you are out there on the net drop me a line and let me know. From Boston, **Howard Reubenstein,** Secretary, 38 Belknap St., Somerville, MA 02144."

Stephanie (Helfferich) Hailperin and her husband Max ('85) sent me a card letting me know about Karl Hailperin, their new baby boy, born on May 17, 1989. Congratulations! . . . **Andrew Leuzinger** wrote that he has moved back into the Bay area from Japan (where he spent the last six months teaching English) and is working for Lightwave Electronics in Mountain View.

Robert Hall is working on a master's degree in electrical engineering at the University of Waterloo. . . . **Selina Lin** graduated from medical school (in May) and is doing her residency in obstetrics and gynecology at the University of Alabama in Birmingham (hope you get paid enough to cover your insurance bills, Selina!). . . . **Mihai Manoliu** says that he is an "independent music producer/songwriter, free-lance writer on music technology, programmer/consultant for Oracle database applications, teacher of music theory and improvisation, tutor of high school subjects" and is currently editing material for a book on music improvisation and a collection of poems; but is considering a "real career" as a knowledge engineer. . . . **Daniel Tani** is working as a structures engineer for Orbitac Sciences Corp. in Fairfax, Va. He also says to "watch for maiden Pegasus flight in August 1989!"

I am still living in the San Francisco Bay area working for Alza Corp. and am very busy keeping up with my volleyball schedule. That is it for now-remember, you have to write in to help Howard get off to a good start! It's been fun (?)! Take it easy-I know that I will!—**Mona Wan,** Secretary, 12231 Viewoak Dr., Saratoga, CA 95070

85 5th Reunion

Max Hailperin and Stephanie (Helfferich) Hailperin, '84, had a baby boy, Karl on May 17. **Jan Krueger** and **Bernard Gunther** were married on April 19. While Jeff and I were at **Dan Weldman** and Sue Gindlin's wedding on June 18 we saw **Scott Chase, David Todd, Mike Davon, Carl Pietrzak** and Irina Rakin, '86.

Chun-Nip Lee graduated from Princeton with a Ph.D. in mathematics in June. In August he tied the knot with Suk Ning Kan ('86, Columbia University) after "all these years." The wedding was in NYC and attended by **Hans Lee, Tom Tam, Yi Tso,** Allix Chung, '86, Man-Wai Kwan, '86, Phillip Mak, '86, and Sherman Luk, '87. Chung-Nip and Suk Ning moved to the West Coast where he accepted a postdoctoral fellowship at the Mathematical Sciences Research Institute of Berkeley.

Jon Morrow is in Chicago beginning a four-year residency in obstetrics and gynecology at the Prentice Women's Hospital of Northwestern University's Medical School. . . . **Peyman Pakzaban** graduated from the Baylor College of Medicine where he was a DeBakey Scholar. He will be serving his residency at Massachusetts General in neurosurgery. . . . **Joe Kilian** received a Mathematical Sciences Postdoctoral Research Fellowship from the NSF. He is doing research at U.C. Berkeley.

Paul Gabuzda completed his MP (half of an MBA) at UCLA's Anderson Graduate School of Management. He spent the summer working in Commercial Aircraft Finance at Citicorp. He expects to receive his MBA next June. **Gary Agranat** spent some time as a graduate co-op student at the NASA Goddard Space Flight Center outside of Washington in the cryogenics, propulsion, and fluid systems branch. In August he returned to the Polytechnic University in New York to finish his master's degree in aerospace engineering. Prior to working at NASA he had a graduate internship with the NYC Department of Environmental Protection. His job was to help take and analyze

pollution data from the city harbor waters on board a research boat.

David Lineman is in Houston working for Schlumberger Well Services. Ever since he finished his master's ('86) at MIT in geophysics he has been working as a Signal Processor for Schlumberger—"proving the old adage—sooner or later, everyone goes Course VI." . . . **Richard Corkran** is a corporate pilot working for Du Pont. He flies business jets around the U.S., Canada, and Mexico—"a great job!" . . . **Roy Peterkofsky** left the Association of American Railroads. He is now in operations research at US Air. He is deeply involved in the restructuring the company's system after it's merger with Piedmont.

Bill Messner finished his SM in mechanical engineering at Berkeley and is now going for his Ph.D. Last December through March he traveled the world visiting Japan, India, Nepal, France, Austria, Italy, Spain, and England. In most places he had people to visit, including some MIT grads. Billy Gordon, '87, and Megan Smith, '86, are in Japan. Megan is working for Apple and Billy is working for an architecture firm. He also saw Cathy Kim, '88, in Paris. Of all the places he went the first that he would return to is India. Although not the most pleasant in many ways, it was certainly the most interesting. He found people to be the friendliest in Japan. One man even allowed him to stay at his house when he was stranded outside of Tokyo when the trains stopped at midnight. Bill saw **Andy Renshaw** in California. They went bike riding before Andy continued his ride to L.A. from San Francisco. Andy started his internship at the Brigham and Women's Hospital in June. Andy's specialty is pathology. **Jim Hutchinson** and Nancy Defeo, '84, are doing well. **Dave Sherman** is still working for Rogers Corp., but he has changed divisions.

Alec Atkin has been living in the Osaka area of Japan for the past year teaching English (until June). Since he thinks that is not one of the most stimulating things in life he spends most of his time off studying Japanese, bicycling, and watching Japanese dramas and suspenses on TV. In June he started a new job as an overseas manager for a mid-to small size company (outside of Osaka) that makes surface grinders. He doesn't think he could have gotten the job without a degree from MIT. It seems to have more prestige in Japan and opens more doors than in the U.S. He writes that Stephanie Taddy, '88, is doing research in Tokyo "to save the planet." She came down to visit him last February. She says there are many alumni in the Tokyo area. He has been in touch with **Celia Lee.** She has a new job at a place called Thermionics.—**Stephanie Winner,** Secretary, (internet:winner@apple.COM), 1026 Live Oak Dr., Santa Clara, CA 95051, (408) 985-6827

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David Cultice enters Clemson University in South Carolina this fall to study for his master's in mechanical engineering, concentrating on robotics and artificial intelligence. . . . **Richard Hermann** graduated from Stanford in January 1988 with a master's in exploration geophysics. He is now a development geologist with Chevron U.S.A. in Bakersfield, Calif. . . . **Ramon San Pedro** works for Cameron Forge Co. in Houston. Last November 25, he married Sylvia Perez, '88. . . . **Farzin Motamed** lives in Binghamton, N.Y., and works for GE Aircraft Control Systems.

John Rulnick is studying optical control systems. He spent four months exploring Europe earlier this year. . . . **Robert Sabo** is in his fourth year at Jefferson Medical College in Philadelphia. He is looking for a residency. . . . **Michael Bates** spent a five-week company assignment in London, installing and testing an update to a 737 simulator used to train ground maintenance engineers for British Airways. He planned to get married on July 22 to Mikki Marugg, a University of Arkansas graduate whom he's been dating for three years. Mike expected to see a number of ZBTers at the wedding. . . . **Jennifer Solomon** finished her first year at Wharton Business School and worked in New York City this summer at Time, Inc. . . . **Robert Bieri** is working on his PhD thesis on fusion energy at Lawrence Livermore National Lab.

Ann Zabladoff is having a great time at Harvard graduate school, in astronomy. Her old roommate, **Ellen Spero,** is finally tying the knot: she is marrying **Steve Wheatman**. . . . **Matt Dorn** planned to marry Jane Doughman, an employee at Wright-Patterson AFB, Ohio. . . . After graduation **Todd Fujinaka** went to work for Mitsubishi Semiconductor America, Inc. He then left to work for Mitsubishi Electric Corp. in Japan, and that's where he's been since.

Brian Mulcahey worked as a technical consultant for Booz Allen & Hamilton in Bethesda, Md., since graduation. However, starting this fall, he attends the University of Chicago School of Business. Brian and **Rob Katz** recently visited a Wellesley friend in Palo Alto, Calif. Rob is a graduate student in the computer science department at the University of North Carolina at Chapel Hill. Brian also saw **Carl Tung** before Carl left for Taiwan to visit his fiancee. Carl planned to return at the end of the summer to attend RPI for his master's in electrical engineering. . . . **Phil Pan** begins his second year as an MBA student this fall at the University of Michigan at Ann Arbor. . . . **Yona Kaplan** writes from Troy, Mich., that she works for EDS on a materials management system, and she's having fun in the motor city. If anyone gets the chance to visit, Yona says to give her a call.—**Mary E. Cox,** Secretary, 1800 Hermosa Ave., #A, Hermosa Beach, CA 90254

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Jon Kramarsky had a barbecue to celebrate the July 4th weekend. He's got a great house in Brookline and has fun with old friends from the Delt house. . . . **Mintoo Bandahri** was at the party—he'll work in Boston another year before attending Harvard Business School next September. . . . **Jordan Levin** didn't make it to the party because he was visiting Glen (Reggie) Grandea, '85, in San Diego. . . . **Bob Vokes** is still in town, but rumor has it that he'll leave soon to work for McKinsey in Europe. . . . **Julie Zimmerman** will move back to the Boston area soon. . . . Congratulations to **Hee Jung Koh** and Andy Wescoat, '85—they were married on August 19.

Jon Suber, Dan Kennedy, Lowell Kim, Anthony Scotti, '86, T.J. Craddick, '88, and I went to see Don Woodlock, '88, play with one of his latest bands, Different Drum. . . . I spent my summer working for the Division of Capital Planning and Operations (DCPO) for the Commonwealth of Massachusetts. . . . Classmate **Phil Koebel** has worked for DCPO since graduation in the Office of Capital Budgeting. Phil lives in Somerville and still plays soccer. Unfortunately for Capital Budgeting, Phil will move to northern California in the fall.

The remainder of these notes are brought to you by **Kip Fern** and **Terry Huang:** "Looks like the Bay Area is the place to be for a bunch of '87 alumni. Berkeley graduate students **Mark Mastandrea** and **Dave Wietz** decided against PhDs in chemistry, and so they each graduated in May with a master's. Dave now thinks he wants to be a lawyer, so he's off to the University of California at Davis in the fall to get his law degree. Mark joins the work force at Oracle in Belmont, Calif. Mark can't wait to spend 'only' 60 hours per week on his new job (chem lab took him around 100 hours per week. Mark will live with **Kip Fern** in their new condominium. Kip has just completed his first year at Oracle, where he is developing a graphics toolkit for the Macintosh. . . . **Mike Judy,** unlike Dave and Mark, passed his EE prelims at Berkeley and is still chugging along towards his PhD. Mike went to Europe in the summer for a few weeks.

"Joining the California ranks are **Heather Beck** and **Kaveri Suryanaryan.** Heather quit her job in Waltham, Mass., and attends Berkeley this fall to pursue a graduate degree in mechanical engineering. Heather planned to drive across the country with Cat Chow, '88, and Joyce Chow, '90. Kaveri will spend her third year of medical school at Stanford doing research, and will then return to Duke for her fourth year. Kaveri will live with Greg Marek (who would have graduated with our class if he hadn't transferred to Stanford in his Junior year.) Greg has been working at Oracle for the last two years, and is now a product manager. Belated congratulations are in order for Kaveri and Mark who were engaged a year ago. They plan to be married in two years, when Kaveri finishes medical school. . . . Also in California is **Terry Huang.** Terry graduated with his master's in electrical engineering from the University of Michigan, and now works for Hewlett-Packard in Santa Clara doing chip design. Terry is engaged to Nina Uehara, whom he met at the University of Michigan. Terry shows everyone his new bright red MX-6.

"**Kelvin Phoon** works for Booz, Allen and Hamilton in Maryland. . . . **Val Brown** is at the University of Pennsylvania, working on her PhD and tutoring the football team. . . . **Alex Chow** is at the University of Florida (Gainsville), entering her third year of Medical School." Thanks for all the help, Kip and Terry! Now it's someone else's turn. Write me.—**Stephanie Levin,** Secretary, 41 Prentiss St., Cambridge, MA 02140, (617) 547-6673

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Imagine my surprise when I received a letter from **Garett Leskowitz** regarding his "reported death" in April's column. Apparently there's been a big mistake. Neither **Andy Hong** nor Garett is dead. Andy is finishing his degree at MIT, and Garett lives and works in the Somerville area. I regret the misinformation and am sorry for any personal distress this may have caused. . . . **Herbert Ernest** sends a message from Amsterdam to friends: "Not just stoned, but beautiful." He also visited family in Germany and planned to teach high school in September. In April, Herbert met **Roel Hammerschlag** in Amsterdam. Roel is "busy becoming Dutch, as well as improving and testing hearing aids."

News from Kappa Sigs: **Bob Bielinski** has transferred to Chicago from his New York office. . . . **Andy McAfee** works for Boeing. . . . **Young Shin** works for Morgan Stanley in New York City and plays softball for the company team in Central Park all summer. . . . **Mikey Teng** is "surviving" long lab hours at the University of Chicago.

Craig Jungwirth recently worked on the opening of the new MGM Theme Park in Florida. . . . **Kelly O'Neill** spent six weeks in Europe with **John Ramsey.** She works for Lincoln Labs, and John has accepted a job in California. Both graduated this year. . . . **Marty Scheidl** says his job is a little better: he only works 60 hours a week now. . . . **Marcos Esterman** spent the summer having fun in the California sun. . . . **Abdun Ruiz** works for Baybanks and is thinking about moving up in the world to bigger and better things.

Christine McIntyre writes from Washington, D.C., that she spent the summer working at NIH in the cardiac surgery division of the Heart, Lung, and Blood Institute. She went canoeing on the Potomac with **Mike Couris.** Mike moved to D.C. from Arlington, Va., so that he wouldn't have to commute to Georgetown School of Medicine. . . . **Chris Saito** was selected for jet training in Pensacola for five months; after that, he's assigned to an aircraft carrier.

Most of the news this issue came from our illustrious president, **Lisa Martin.** Without her help, this would have been about one paragraph long. We need more people writing in with good gossip.—**Grace Ma,** Secretary, 435 E. 30th St., New York, NY 10016

COURSE NEWS

I CIVIL ENGINEERING

MIT Assistant Professor **Andrew Whittle,** ScD '87, has received the 1989 Doherty Professorship in Ocean Utilization administered by the Sea Grant College Program. Whittle will receive $25,000 each year for two years to conduct research on soil behavior. He won the career development appointment with a proposal to develop a constitutive model for describing the important aspects of the time-dependent behavior of cohesive soils. His research has a number of applications in offshore engineering, including soil-structure interaction due to cyclic wave loading, long-term pile capacity, and displacement of rigid gravity structures because of lateral ice loading. . . . **Mark D. Bucknam,** SM '82, has been promoted to office manager of the Manchester, N.H., district office of Goldberg-Zoino & Associates, Inc. He is responsible for a "highly diversified environmental and geotechnical engineering business which provides services for the construction, waste management, and manufacturing industries, as well as infrastructure development such as water resources and highways," according to a news release.

Rafael L. Bras, '72, MIT professor and director of the Parsons Laboratory, has been named William E. Leonhard Professor. The chair was established in 1983 by Leonhard, SM '40 (VI), the chairman, president, and CEO of the Parsons Corporation in Pasadena, Calif. Bras, internationally known for his work in surface-water hydrology, has specialized in the interpretation of natural phenomena as random functions. He has been recognized for his use of modern probabilistic methods in the design of networks to monitor rainfall and river discharge forecasting. He recently became a member of the Atmospheric Sciences and Climate Board for the Academy of Sciences. . . . **Stephen J. Kokkins,** SM '65, is running for reelection to the Planning Board of Ipswich, Mass. He is an engineering consultant and developer.

From Laguna Niguel, Calif., **Kenneth C. Reynolds,** ScD '37, writes: "I taught at MIT for 24 years—1920 to 1944—and have many warm feelings toward the Institute during those years. I was a professor at the Cooper Union in New York City and rounded out my 44 years of teaching civil engineering at the University of Southern California. Following the passing of Ruth Reynolds after 55 years of marriage, I married Marjorie Vincent Reynolds four and a half years ago. We have made many trips. In fact, she took me to Hawaii for my 92nd birthday. I seem to be in the best of health and we greatly enjoy each other's companionship."

At least two Course I alumni were among those inspecting the damage in Armenia from the earthquake last December. **Peter Yanev,** SM '70, who was part of a group of engineers sponsored by the Soviet Academy of Sciences and the U.S. National Academy of Sciences, found the destruction far greater than he expected. "After visiting more than 25 earthquake areas throughout the world, I though I had seen it all. I hadn't," he said. And **Mishac K. Yegian,** PhD '76, professor and chairman of the Civil Engineering Department at Northeastern University, traveled with a doctoral student to Armenia at the invitation of the Armenian Academy of Sciences and the Polytechnic Institute of Yerevan. Yegian found that the speed of the reconstruction effort was laudable, although the very pace of rebuilding permanent housing and other structures seemed to preclude a thorough evaluation of seismic considerations, according to an interview with him in the Watertown, Mass., *Armenian Weekly.*

Neal B. Mitchell, Jr., SM '59, a former city engineer for Salem, Mass., died March 26 of a heart attack at his home in Clearwater, Fla.; he was 83. At the time of his death he was enrolled in a computer programming course, having begun his computer studies at age 80. Mitchell was a registered land surveyor, and served on the board of directors for the South Essex Sewerage Board and the Salem Beverly Water Supply Board, all in Massachusetts. He was a Fellow of the American Society of Civil Engineers, a former officer of the Tampa section of the American Society of Military Engineers, and a Mason. . . . **Stanley L. Brown,** '33, of Flicksville, Penn., died on April 15. He had studied railroad operations at MIT in the early 1930s. Brown was a World War II army veteran and a 50-year member of the Seventh Regiment U.S. Army of New York City. Before retiring in 1974, he was a sales representative for the DeLuxe Corp. for 42 years.

II MECHANICAL ENGINEERING

Theodosios P. Korakianitis, ScD '87, is assistant professor of mechanical engineering at Washington University in St. Louis. He is teaching graduate and undergraduate thermodynamics, piston engines, turbomachinery, and design. He received one of the 1989 Ralph R. Teetor Educational Awards from the Society of Automotive Engineers (SAE). Korakianitis was faculty advisor to the Washington University team that converted a 1989 Corsica to run on methanol and entered the Methanol Marathon Competition. . . . University of Texas Professor of Biomedical and Mechanical Engineering **Kenneth R. Diller,** ScD '72, has been awarded an NIH fellowship to conduct research at Cambridge University in England. As a Senior International Fellow, he will spend a year beginning in July working with Dr. David Pegg and his staff on the biophysics of cell freezing; they will study the freezing processes in a multicellular tissue, the pancreas islet. The research will directly benefit current medical practices in organ and tissue cryopreservation, and could be applicable to the transplantation of pancreas islets into diabetic patients, according to an NIH press release. Diller recently developed a cryomicroscope apparatus that allows one to observe and document the freezing process at the cellular level.

R.F. Probstein

MIT Assistant Professor of Mechanical Engineering **Shahryar Motakef,** '78, has been named the first holder of the Samuel C. Collins Junior Faculty Development Chair. The chair honors the late Professor Collins, who was internationally known as a pioneer in the development of practical helium liquifiers and as the founder of the MIT Cryogenic Engineering Laboratory. He taught at MIT for more than 30 years and died in 1984. Motakef has made significant contributions through experimental and analytical investigations to the understanding of the processes controlling growth of electronic materials. His work spans the disciplines of the thermal/fluid sciences and materials processing and is directed to overall closed-loop control of crystal growth processes.

Recently retired Course II faculty: **Stanley Backer,** '41; **James A. Fay,** SM '47 (XIII); and Ford Professor of Engineering **James C. Keck.** . . . Newly named as Ford Professor is **Ronald F. Probstein,** known for his teaching and research on hypersonic flows, water desalination, and electroosmotic methods for removing soil contaminants. The Ford Professorship is awarded to distinguished faculty who are recognized as innovators and leading influences in their disciplines. Probstein, a member of the faculty since 1962, has directed his recent efforts to the area of physicochemical hydrodynamics, dealing with the interaction between fluid flow and physical, chemical, and biochemical processes. His work in removing soil contaminants has led to the development of a patented process which is being evaluated in laboratory pilot studies. He has been elected to the NAE and the American Academy of Arts and Sciences; he is a Fellow of the American Institute of Aeronautics and Astronautics, the American Physical Society, and the American Association for the Advancement of Science.

The Alumni/ae Association has been notified of the death of **Charles S. Reasby,** SM '33, of Worcester, Mass., on May 30, 1989. No further information was provided.

III MATERIALS SCIENCE AND ENGINEERING

The American Physical Society has announced that MIT Professor **Robert W. Balluffi,** '47, is the recipient of the 1989 David Adler Lectureship Award. The citation reads, "For his seminal experimental and analytical contributions, which have clarified our fundamental understanding of the atomic mechanisms of sintering, Kirkendall

phenomena, dislocation climb, solid-state diffusion, the production and recovery of radiation damage, grain boundary structure and energetics in metals and ceramics, and his accompanying lucid writing and verbal skills in presenting these investigations." . . . **Michael E. Prengaman,** SM '84, has been named manager of forming and green machining in The Timken Co.'s Technology Center. Beginning at the company in 1977, Prengaman has progressed from metallurgical trainee to process metallurgical engineer to manager of forming/heat treat prior to his most recent promotion.

Dennis W. Readey, ScD '62, professor and chairman of the department of ceramic engineering at the Ohio State University, has accepted a new professorship created by an endowment from the Adolph Coors Foundation in the Colorado School of Mines' metallurgy and materials engineering department. As the Herman F. Coors Professor of Ceramics, Readey will be responsible for working with faculty from the Mines departments of chemistry, metallurgy, engineering, and physics to form an interdisciplinary curriculum to support ceramics research, and move products of research from the lab to the marketplace more rapidly.

IV ARCHITECTURE

Furniture designer **George Nakashima,** MAR '30, had an exhibit of his work from 1945 to the present at the American Craft Museum in New York City this summer. His one-of-a-kind pieces, which emphasize wood grain and shape, range in price from $200 for a small stool or side table up to $20,000 for a large dining table. Nakashima's solid-wood designs blend traditional and contemporary forms. His book, *The Soul of a Tree* (Kodansha Press), describes how he chooses his material with the help of spotters who go out in the woods in search of trees with the right potential. . . . **John H. Larson,** MCP '55, the retired CEO of the Southern Connecticut Gas Co., has taken on a new volunteer job: that of chief financial officer of Bridgeport, Conn., for eight months until the November elections. As interim finance director he is responsible for beginning to straighten out a "convoluted financial situation—one so extreme that its finances are under the ultimate control of a state-created review board," according to the Bridgeport *Sunday Post*.

Architectural historian **Nancy Stieber,** PhD '86, has received a 1989 J. Paul Getty Postdoctoral Fellowship in the History of Art and the Humanities. The assistant professor at the University of Massachusetts/Boston is one of 15 scholars who has received a doctorate within the past six years and been awarded a grant designed to free them from their professional careers for a year of research and writing. Stieber's project is entitled "Twentieth-Century Urban Planning and the Pictorial Representation of the City in the Netherlands."

N. John Habraken has recently retired as professor of architecture at MIT.

V CHEMISTRY

Peter P. Policastro, PhD '83, has recently joined Pyrotite Corp., Miramar, Fla., as vice-president of R&D. Pyrotite Corp. is an emerging growth company commercializing novel fire-resistive materials technology. He, his wife, Nancy, and their two children, Daniel and Lisa, make their home in Coral Springs, Fla., and Nantucket Island, Mass. . . . **David B. Sclove,** PhD '72, is director of vendor storage products at IBM Corp. in White Plains, N.Y. He lives in Ridgefield, Conn. . . . **Melvin L. Loeb,** PhD '69, has been appointed vice-president of R&D for Wesley Jessen, Schering-Plough Corp.'s vision care business. He is a member of the American Chemical Society,

M.E. Prengaman

M.L. Loeb

serves on the board of editors of the *Research-Technology Management Journal*, and is a company representative to the Industrial Research Institute. . . . **Peter Legzdins,** PhD '68, has received the Alcan Award, sponsored by the Aluminum Company of Canada. The award consists of a $2,000 honorarium and a scroll, and is presented to a scientist residing in Canada who has made a distinguished contribution in the fields of inorganic chemistry or electrochemistry while working in Canada. Legzdins is a professor of chemistry at the University of British Columbia; his research interests are centered on synthetic, structural, and bonding studies of organometallic complexes that can be used as specific reactants or selective catalysts in organic or organometallic syntheses.

MIT Professor of Chemistry **Robert J. Silbey** has been appointed to hold the Class of 1942 Professorship for a five-year term. The professorship was established to recognize innovative teaching by outstanding faculty members whose careers reflect the traditional close coupling of teaching and research at MIT. Silbey's research interests are theoretical chemistry, excitations in solids, vibronic interactions in molecules and solids, and electronic properties of polymers. He received the School of Science Teaching Award in 1986 and a Graduate Student Council Teaching Award in 1988. He holds a BS from Brooklyn College and a PhD from the University of Chicago, and has taught at MIT since 1966. . . . **Ellen Bressel,** PhD '60, has been appointed director of clinical services at Medical Device Consultants, Inc., in Attleboro, Mass. She will be responsible for managing all activities related to clinical investigations of medical devices including study design, coordination and monitoring of clinical studies, preparation of investigator materials, and data processing, statistical analysis, and reporting for regulatory submissions and post market surveillance.

Alfred Stockfleth, PhD '42, died June 21, 1988, of heart failure in Wilmington, Del. He worked at the Du Pont Co. for 36 years before retiring in 1978. He started as a research chemist and later became a sales engineer in the plastics department. He developed the extrusion coating process for coating paper and aluminum foil used primarily in food packaging containers. He also invented several plastic processing methods and was the author of several articles on the subject. Stockfleth was a founding member of the Skating Club of Wilmington, and a longtime member of the Philadelphia Skating Club & Humane Society.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

MIT Professor **Berthold K.P. Horn,** PhD '70, is one of two faculty members to receive a Rank Prize, awarded by the Rank Foundation of England. The prizes recognize and foster significant advances in two areas of science—human and animal nutrition and crop husbandry, and optoelectronics, which explores the interface between the science of optics and the technology of electronics. Both were of particular interest to the late Lord Rank, who established the funds just before he died in 1972. Horn, a member of the Artificial Intelligence Laboratory, has been widely recognized for his work in the areas of machine vision, image understanding, spatial reasoning, and robotic motion. He has been an innovator in inferring three-dimensional shapes from the shading present in images. Each Rank Prize winner receives 25,000 pounds sterling, or approximately $40,000. . . . **Charles A. Steinberg,** SM '57, is now president of Sony Corp. of America, Inc.'s Business & Professional Products Group in Park Ridge, N.J. He was previously the president of the Non-Consumer Business Group. . . . **John C. Mitchell,** PhD '84, is now teaching in the Computer Science Department at Stanford University.

MIT Assistant Professor **David L. Tennenhouse** has been named to hold the KDD Career Development Professorship in Communications and Technology for a two-year term. The chair was established in 1983 by the Kokusai Denshin Denwa Co., Ltd., of Tokyo. Tennenhouse's research is in the systems aspect of telecommunications. His present work is concentrated on the design of an advanced (broadband) network architecture and the development of high resolution (HDTV) workstations and applications. . . . **John Delmonte,** SM '34, was honored last spring by the Glendale (Calif.) Unified School District Board of Education, which gave him its Burtis E. Taylor award for extraordinary dedication to public education. Delmonte is more accustomed to being on the bestowing end of education awards, having created the Glendale Chamber of Commerce teacher recognition awards in 1980, as well as having established, eighteen years ago along with his wife, Janet, scholarship funds for Glendale Unified and Glendale Community College students majoring in science or math. He is a plastics industrialist, has written 10 books on the technical aspects of engineering and physics, and is an avid traveler and mountain climber.

Former astronaut **William B. Lenoir,** '61, has been named to head the NASA space station program. NASA hopes to have the space station *Freedom* in orbit in the mid to late 1990s and has requested $2 billion for it in the FY-90 budget. Lenoir, who flew on the fifth space shuttle mission, is currently a vice-president of the Booz-Allen & Hamilton consulting firm in Arlington, Va.

Scott Davidson, '73, was the guest editor of a special issue of *Computer* magazine on "Software Tools for Hardware Test." In his introduction, Davidson explained why a whole issue was being devoted to testing: "Because the automatic generation of test vectors and their evaluation through fault simulation are extremely complex and time-consuming operations, consuming hours and days of computer time. The complexity of the circuits on which these tools are used is growing faster than the speed of the computers on which they run. New algorithms and techniques are required for both the circuits of today and tomorrow. The techniques for solving complex problems in the physical sciences, such as vectorization and the exploitation of parallelism, do not lend themselves to solving testing problems. The purpose of this issue is to expose these problems to a wider audience and, perhaps, stimulate research that will find solutions." Davidson is the supervisor of the Automatic Test Generation, BIST CAD and Diagnostic Group at the AT&T Bell Labs Engineering Research Center in Princeton.

Howard L. Yudkin, PhD '65, died of a heart ailment on May 23, 1989, at age 52.. He was president and CEO of the Software Productivity Consortium in Herndon, Va., and a former deputy assistant secretary of defense for telecommunications. Yudkin worked as an electrical engineer at MIT's Lincoln Laboratory until 1970, when he moved to Washington, D.C. and joined the Department of Defense. After four years there he left to become president of the Computer Science Corp.'s systems division. In 1982, he moved over to Booz-Allen & Hamilton in Bethesda, Md., as a vice-president, where he remained until joining the Software Productivity Consortium in 1986.

VI-A INTERNSHIP PROGRAM

On June 5, 1989, MIT's Commencement Exercises took place on a cloudless ideal New England day. The rhododendrons bordering Killian Court were in full flower. All the speeches poignantly touched on the struggle for democracy taking place in Beijing, China. Of the graduates, 96 were VI-A students: 66 simultaneously receiving both the Bachelor's and Master's degrees and 30 others, the Bachelor's degree. Many of the latter group will continue on to the graduate phase of the VI-A Internship Program.

Two new VI-A alumnae are twins and have three older sisters who are also MIT grads. **Alice I.** and **Charlotte E. Biber,** '89, of Needham, Mass., received Bachelor's degrees and will continue on to the graduate phase of the Program.

On Commencement morning the MIT Corporation met and elected two life members and nine term members. Reelected as a five-year term member is **Raymond S. Stata,** SM '58, cofounder, chairman and president of Analog Devices, Inc. Ray was also placed on the Corporation's Committee on the Presidency to select a replacement for the president, **Paul E. Gray,** '54, who leaves the post come June 1990.

VI-A's continue to do well in the leadership of MIT's Tau Beta Pi Chapter. This year's president, **Henry H. Houh,** '89, has the honor of having been selected a 1989 Laureate of the Tau Beta Pi Association—one of 21 members so selected in the first eight years of the award. One of this year's other Laureate selectees is a Tau Bate from Course II-B.

It's always good to see the VI-A members of the 50-Year Class who attend graduation or the Technology Day activities. VI-A's listed among the Class of '39 included **George R. Blake, David S. Frankel, Clinton C. Lawry, Jr., Frederick F. Schaller, Jr.,** (all SM '40) and **Donald N. Timbie,** '39. Mr. Lawry came by the VI-A Office and had a long chat. Several others were at the president's afternoon reception for the 50-Year Class which I attended.

Former VI-A Director, Professor **J. Francis Reintjes,** informs me that the new VI-A Coordinator at GenRad is **Henry P. Hall,** SM '52. Mr. Hall was in the Williams College/MIT combined plan and at MIT was in "Course VI-A" doing his VI-A work at the General Radio Co. (later to become GenRad). He was elected to both Phi Beta Kappa (Williams) and Tau Beta Pi (MIT). It's always helpful to have former VI-A'rs as company coordinators because they are familiar with the objectives of the Program!

Speaking of GenRad, one June Sunday at church in Wellesley a parishioner spoke to me and it was **Harold T. McAleer,** SM '53, retired senior vice-president of GenRad.

Attending Associate Professor **Charles G. Sodini's** Associative Processing Project Review at MIT in June was **William R. Bidermann,** SM '79.

Another day in June I met **Jon P. Wade,** ScD '88, with some luggage in Building 36. He said he had finished work at Thinking Machines and was taking a year off to travel.

At the Commencement reception for School of Engineering graduates I met **Edison H. Wong,** SM '87, and we had a pleasant chat. He's in his second year of medical school at Columbia University.

Two other visitors signing our VI-A Guest Book, since our last writing, were **Dean R. Collins,** SM '59, with Texas Instruments/Dallas, and Professor **Denice D. Denton,** PhD '87, on the faculty of the University of Wisconsin at Madison.—John A. Tucker, Director (Emeritus) VI-A Internship Program, MIT, 77 Mass. Ave., Rm 38-473, Cambridge, MA 02139.

VII BIOLOGY

MIT Associate Professor **H. Earl Ruley** has been named to hold the Latham Family Career Development Professorship for a two-year term. The chair was established in 1985 by a gift from Allen Latham, Jr., '30 (II), and his wife, Ruth. Latham and the four Latham children hold eight MIT degrees among them. He is the founder and chairman of Haemonetics Corp. of Braintree, Mass., which develops, manufactures, and sells systems used for the preparation of clinically useful quantities of blood platelets from donors for the support of patients undergoing intensive cancer chemotherapy. Ruley's research focuses on the analysis of oncogene function, including the physiological circuitry of the interactions among oncogenes and growth factors in malignant transformation, and the involvement of oncogenes in atherosclerosis. He has a BA in anthropology and a PhD in bacteriology and immunology. In 1984, the year he joined the MIT faculty, he was selected as one of America's 100 brightest scientists under 40 by *Science Digest*.

Recently retired from the Department of Biology is **Herman N. Eisen,** Whitehead Institute Professor of Immunology.

VIII PHYSICS

MIT Professor Emeritus **William P. Allis,** '23, has donated his professional library to the David J. Rose Library at the Plasma Fusion Center. The collection of some 600 volumes includes works of historic significance in plasma physics. . . . **Shirley Jackson,** '68, the first black woman to receive a doctorate in physics in the United States (from MIT in 1973), is one of six women to receive the New Jersey Women of Achievement Awards. The awards were established eight years ago by Rutgers University's Douglass College, the largest college for women in the country, and the New Jersey State Federation of Women's Clubs, the largest volunteer organization for women in the state. "The New Jersey Women of Achievement are a real inspiration to the young women of the state," said the dean of the college. "By their example, they encourage our young women to dream big dreams and to become tomorrow's women of achievement." Jackson is a theoretical physicist at the AT&T Laboratories. She has lectured widely both on physics and on the role of blacks and women in science and engineering. She is a member of the N.J. Commission on Science and Technology, and has served on the National Academy of Sciences and National Science Foundation committees. . . . Recently retired from the Department of Physics is Professor **Peter T Demos,** PhD '51.

Timothy R. Hart, PhD '70, has been appointed head of the department of physics and engineering physics at Stevens Institute of Technology in Hoboken, N.J. The author of more than 20 publications, Hart's research interests focus on laser and sold-state experimental research. He has established a research laboratory devoted to Raman and inelastic light-scattering spectroscopy of a wide range of materials including magnetic solids, polymers, biological materials, and semiconductors. He is currently developing temperature measurement diagnostics for optical storage media. . . . Two Course VIII faculty are among a distinguished group of scientists assembled to guide the Superconducting Super Collider (SSC) Laboratory to be built in Texas. William C. Coolidge Professor **Jerome Friedman** and Thomas Dudley Cabot Professor **Samuel C.C. Ting** were chosen to be on the Scientific Policy Committee. One of the Committee's first concerns will be the initiation of the experimental program: how experimental areas should be configured, how experiments should be selected, how detector construction and operation should be managed, and how best to organize international participation in the SSC. The SSC Laboratory is under the direction of **Roy F. Schwitters,** '66, and more than 1,000 scientists from around the world are expected to participate in its experiments.

Three recent awards from the American Physical Society: MIT Professors **Henry W. Kendall,** PhD '55, and the aforementioned **Jerome Friedman** , along with Richard E. Taylor of the Stanford Linear Accelerator Center have been named co-recipients of the 1989 W.K.H. Panofsky Prize. The citation reads, "For their leadership in the first experiments on the deep inelastic scattering of electrons with protons, deuterons, and heavier nuclei. These lepton-nucleon scattering experiments, which were the vehicle for the discovery of the "scaling" phenomenon, gave the first direct evidence for a charged, pointlike substructure inside the nucleon. The results of these high quality experiments still stand and have been supported and extended to higher energies and momentum transfers by later experiments with electrons, muons, and neutrinos." . . . **Richard J. Hawryluk,** '72, and two other scientists from Princeton University have received the American Physical Society's Division of Plasma Physics Award for Excellence in Plasma Physics Research. The citation reads, "For the discovery and scientific exploration of enhanced confinement plasmas with ion temperatures in excess of 20 keV in the Tokamak Fusion Test Reactor." . . . **Cherry A. Murray,** '73, of AT&T Bell Laboratories has been named the recipient of the 1989 Maria Goeppert-Mayer Award. The citation reads, "For the elegant and direct experimental methods she used to discover 'two stage' melting in two-dimensional arrays of polystyrene spheres, her elucidation of the role defects play in this phenomenon, and for pointing out the connection between her discovery and recent theories of melting in two dimensions."

The Alumni/ae Association has received word of the death of **E(ugene) Paul Johnson,** '37, on February 23, 1989, at his home in Highlands, N.C. No further information was provided.

IX BRAIN AND COGNITIVE SCIENCES

Two Course IX faculty members have been appointed to career development professorships. **Christopher G. Atkeson,** PhD '86, assistant professor of motor control, has been named to hold the W.M. Keck Foundation Assistant Professorship in Biomedical Engineering for two years. He focuses his research on motor learning in biological and artificial systems, and tests his theories by implementing them on robots and measuring involvement during human motor learning. Atkeson, an Alfred P. Sloan Research Fellow, 1989-91, received the NSF Presidential Young Investigator Award, 1988-94, an NSF Engineering Initiation Award, 1987-89, a Whitaker Health Sciences Fund Doctoral Fellowship, 1984-86, and an NSF graduate fellowship, 1980-83. **Arthur D. Lander** has been selected to be the Edward J. Poitras Assistant Professor of Human Biology and Experimental Medicine for a period of two years. He received both a PhD and an MD from the University of California at San Francisco in 1985, and until joining MIT in 1987, was a postdoctoral fellow at Howard Hughes Medical Institute, Center for Neurobiology and Behavior at Columbia University. Lander focuses his research on the study of the growth and guidance of nerve fibers in the developing brain.

X CHEMICAL ENGINEERING

The Du Pont Co. has named **Dao T. Wu,** ScD '62, a departmental fellow, a designation held by only 12 of the company's scientists. The rank of departmental fellow recognizes scientists who demonstrate exceptional abilities ranging from research creativity to anticipating customer needs. Wu, a Du Pont employee for 29 years, pioneered the use of computers in the R&D of paint for automotive applications. Before computers were commonplace 20 years ago, he perceived and developed a user-friendly computer modeling sys-

tem to improve research effectiveness and productivity. Through his work, he led the development of a variety of software that is now used routinely by Du Pont employees around the world, according to a Du Pont news release. . . . **Murray W. Rosenthal,** ScD '53, associate director of advanced energy systems at Oak Ridge National Laboratory, has been named deputy director of the laboratory. He will also serve as acting director when ORNL Director Alvin Trivelpiece is unavailable. Rosenthal has been at ORNL since 1953. He has been project engineer for design and development of the proposed Pebble Bed Reactor Experiment and had responsibility for long-range planning in ORNL's reactor division. The laboratory has been without a deputy director for 10 years because of the way it was managed, but when Trivelpiece took over in January he decided he wanted a deputy. In recent years, says Rosenthal in the *Oak Ridger,* "the director's responsibility has grown. The director has more to deal with now."

MIT Professor of Chemical Engineering **Robert S. Langer, Jr.,** ScD '74, has been elected to the Institute of Medicine. New members are elected by present active members from among candidates chosen for major contributions to health and medicine or to such related fields as social and behavioral sciences, law, administration, and economics. The Institute's charter requires that at least one-fourth of the members be drawn from other than the health professions. . . . Recently retired from the Department of Chemical Engineering is Professor of Chemical and Food Engineering **Marcus Karel,** PhD '60 (XX).

Philip I. Bachelder, SM '67, died on May 24, 1989, of injuries he suffered in an automobile accident in Tonawanda, N.Y. A resident of Irvine, Calif., he was the supply director at Calcomp in Anaheim since November 1988. Bachelder had worked previously as a manager for James River Graphics in South Hadley, Mass., and at James River Electrographic Division in Portland, Ore.

XI URBAN STUDIES AND PLANNING

Shirley Simpson-Wray, MCP '77, has founded Simpson-Wray Associates, an urban planning and real-estate consulting firm in West Palm Beach, Fla. She had been West Palm Beach's community development coordinator since 1984. . . . The Rev. **Robert G. Howes,** MCP '60, has become something of an itinerant clergyman, traveling to some 30 Catholic dioceses across the country over the years to help them with their planning as a "live-in consultant." Currently he's spending nine months in St. Louis at the invitation of Bishop Edward J. O'Donnell. His role, Howes told the St. Louis *Post-Dispatch,* is to help the local church leaders assess resources, look at the flow of authority and set up models for change. He noted that 60 or 70 U.S. Catholic dioceses have planning offices now, many of them stemming from his recommendations. . . . **Susan E. Brody,** MCP '77, is the new director of Oregon's Department of Land Conservation and Development. For four years she was the director of Eugene's Planning Department before taking the reins of the state's land-use planning agency, which according to the Portland *Oregonian* is "stuck in a furious debate over rural land use and is under scrutiny by the governor about its priorities." Brody told the paper that her job would be to find "common ground" in the tough land-use debates and to take the state into the next round of issues, including concerns over urban growth. "I have a lot of experience dealing with people who are upset or concerned," she said.

MIT Professor **Bernard J. Frieden,** PhD '62, has been named the Ford Urban Development Professorship; his appointment lasts until 1996. A widely known authority on urban planning and housing, Frieden has been a professor of city planning since 1969, as well as the Class of 1942 Professor in the Department of Urban Studies and Planning since 1985, and has served as chair of the MIT faculty since 1987. During 25 years of direct involvement with urban affairs at both national and local levels, he has served on White House advisory committees and has been a consultant to numerous federal and state agencies. He is a Fellow of the Urban Land Institute and a member of the American Institute of Certified Planners. He formerly served as editor of the *Journal of the American Institute of Planners,* and was director of the MIT-Harvard Joint Center for Urban Studies from 1971 to 1975. The author and editor of eight books and more than 50 articles on housing and city developments, Frieden's most recent book, with **Lynne B. Sagalyn,** PhD '80, *Downtown, Inc.: How America Rebuilds Cities,* is being published by the MIT Press this fall. . . . MIT Professor of Sociology **Gary T. Marx** has been awarded the prestigious Jensen Lectureship given biannually by the American Sociological Association and Duke University. The lectureship carries an honorarium of $8,000 and is intended to encourage and make more visible sociological investigations that enrich the common good. Marx will give a series of lectures on the topic, "Windows into the Soul: Surveillance and Society in an Age of High Technology." These will provide the basis for a book to be published jointly by the lectureship sponsors. He recently published *Undercover: Police Surveillance in America.*

A. Der Marderosian

D.T. Wu

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

MIT Associate Professor of Geology and Geophysics **Leigh H. Royden,** PhD '82, is one of the members of the Faculty Advisory Committee on the presidential search. . . . Recently retired from the Department of Earth, Atmospheric, & Planetary Sciences is Professor **William F. Brace,** PhD '53.

William Tupper, PhD '59, professor of earth sciences at Carleton University in Ottawa, has been appointed to the Council of the Natural Sciences and Engineering Research Council (NSERC) in Canada. Tupper was elected as the Member of Parliament for Nepean-Carleton in 1984, and chaired the Parliamentary Committee on Research, Science, and Technology. NSERC is the largest federal granting agency in support of university research in Canada, and has a budget of $390 million.

XIII OCEAN ENGINEERING

Naval Engineering and American Sea Power, a new book edited by Rear Adm. **Randolph W. King,** NE '49, USN (Ret), has four Course XIII alumni among its 15 contributors. The book chronicles "a century of monumental change in maritime technology," according to the jacket. Capt. **Keith B. Schumacher,** NE '60, USCG (Ret) was co-author of "The Declining Years (1922-1932)"; Capt. **Virgil W. Rinehart,** NE '54, USCG (Ret),co-wrote "The Roosevelt Resurgence (1933-1941)"; Rear Adm. **Willis C. Barnes,** NE '52, USN (Ret), took on the period of "Korea and Vietnam (1950-1972)"; and Capt. **John R. Baylis,** NE '51, USN (Ret), contributed "The Six-Hundred Ship Navy and Merchant Marine Doldrums (1981-1988)." The publisher is the Nautical & Aviation Publishing Co. of America. . . . Recently retired from the Department of Ocean Engineering is Professor of Marine Systems **Ernst G. Frankel,** MME '60.

XIV ECONOMICS

J(erome) Phillip Cooper, PhD '72, former executive vice-president of McGraw-Hill, Inc., in New York, is the president and CEO of Applied Expert Systems, Inc., in Cambridge.

Robert J. Shiller, PhD '72, an expert on macroeconomics and financial markets, has been named the Stanley B. Resor Professor of Economics at Yale. He has been a professor at Yale's Cowles Foundation for Research in Economics and at the School of Organization and Management since 1982. He is also a research associate at the National Bureau of Economic Research and serves on the congressional advisory panel of the Office of Technology Assessment, which studies securities markets and information technology. The MIT Press is publishing his book *Market Volatility.*

Assistant Professor **Robert Vishny,** PhD '85, of the University of Chicago's Graduate School of Business, has been awarded a $25,000 Sloan Research Fellowship. His interests include the economics of information and uncertainty, the market for corporate control, and the ownership structure of corporations. Vishny is an associate editor of the *Journal of Finance* and the *Journal of Financial Economics,* and is a faculty research fellow at the National Bureau of Economic Research.

University of Delaware Associate Professor **David E. Black,** PhD '69, is one of four U of D faculty members to receive a $2500 excellence-in-teaching award. The recipients were selected "primarily on thoughtful and enthusiastic evaluations written by students," according to a U of D press release.

MIT Professor **Paul L. Joskow,** an economist who specializes in problems of industrial organization and government regulation of industry, has been named as the next holder of the Mitsui Professorship for a five-year term. The chair was established in 1974 to encourage cultural and technological exchange between the United States and Japan with funding by the Mitsui Group of Japan, one of the world's leading industrial consortia. Among the group's interests are manufacturing industries, mining, trade and commerce, and banking. The areas covered by Joskow's research include analyses of the effects of public utility regulation on prices and efficiency, studies of the supply and demand for electricity, regulatory alternatives for controlling the costs of hospital care, the structure and regulation of the insurance industry, empirical work on technological change, theoretical and empirical analyses of the economic foundations for long-term contracts and vertical integration, and analyses of U.S. antitrust policies. He has taught at MIT since 1972.

XV MANAGEMENT

MIT Assistant Professor of Management **Karl T. Ulrich,** '84 (II), has been selected to be the Ford International Career Development Professor for a three-year term. A member of the Artificial Intelligence Laboratory as well, Ulrich's principal fields of interest are computer-aided design and engineering, operations management, design for manufacturing,and product design management. . . . **John F. Rockart,** PhD '68, director of the Center for Information Systems Research and senior lecturer of management science at Sloan, has been named a director of Comshare, Inc., in

Ann Arbor, Mich. . . . **Milton Namiot,** SM '61, formerly vice-chairman of Crown Brands, Inc. (a subsidiary of H.H.R. Food Industries) in Englewood Cliffs, N.J., has recently become president of Brighams, Inc., in Arlington, Mass. . . . The founder and former president of Edge Computer Corp. in Scottsdale, Ariz., **Alexander B. Cimochowski,** SM '64, is now president & CEO of Delphax Systems in Randolph, Mass. . . . **Lance Murrah,** SM '85, was recently promoted from product manager in the Systems Products Division of Standard Microsystems Corp. (SMC) to district sales manager of the division. He will be responsible for the sale of SMC's line of computer networking products throughout the eastern sector of the United States, supervising the company's rep/distributor sales organization in that area.

Leslie C. Hruby, SM '73, senior vice-president of Technology Marketing Group, Inc., has been elected to the Visiting Committee for the Sloan School. The committee serves as an advisory group to the Corporation and provides appraisal and advice to the School concerning its direction and programs. Visiting committees also help maintain a close relationship between academic procedure and professional practice. . . . **Oscar W. DeShields,** SM '73, an associate professor of marketing at Florida Memorial College, was recently selected as a McKnight Minority Junior Faculty Fellow. According to DeShields, the fellowship will give him the opportunity to spend one concentrated year completing his doctoral requirements at Florida International University. Once he receives a PhD in business administration, he intends to develop a marketing major at Florida Memorial.

Kenneth A. Roe, SM '59, received the National Engineering Award from the American Association of Engineering Societies last spring. He was cited for his "distinguished contributions to the well-being of mankind through a leadership role in engineering, business, and education." He was also honored for his role as one of the nation's key advisors to government and industry on international engineering matters. He is chairman & CEO of Burns and Roe Enterprises, Inc., an architectural, engineering, design, and construction management firm with headquarters in Oradell, N.J.

Pierre Schnebelen, SM '60, of Paris is one of three partners in Valbois, Inc., overseeing development of a proposed all-season resort on the west side of the Cascade Reservoir. The resort, also called Valbois (wooded valley) is to be a ski area, village, and marina complex in the Poison Creek area in central Idaho. Schnebelen, who is president of PSI Resorts, has been involved in international tourism for 25 years, creating such projects as Tignes, Porto Paraty, Val Thorens, and Valfrejus.

Howard J. Madnick, '87, and his fiancee have taken over as managers of Langley Castle, a luxury hotel built in the fourteenth century for other purposes. The English castle near the Scottish border 30 miles west of Newcastle belongs to his father, Sloan School Professor **Stuart E. Madnick,** '66 (VI). The younger Madnick will be on-site manager for the small four-year-old hotel until he begins law school. There is a special package for MIT alumni/ae, students, and staff who want to stay at the castle, which has eight bedrooms, a drawing room, and a restaurant.

Dennis L. Meadows, PhD '69, is one of 17 futurists profiled in *What Futurists Believe,* a Lomond Publications book by Joseph F. Coates and Jennifer Jarratt.

Recently retired from the MIT School of Management are Professor Emeritus **William F. Bottiglia** and Germeshausen Professor **Jay W. Forrester,** SM '45 (VI).

The Alumni/ae Association has been notified of the death of **David S. Turnbull,** SM '51, of Sparks-Glencoe, Md., on October 17, 1988. He was majority owner and secretary/treasurer of Atlas Container Corp. No further information was provided.

Sloan Fellows

In Philadelphia, **William O. Albertini,** SM '82, has been promoted to president & CEO of Bell Atlantic Enterprises Corp. (a subsidiary of Bell Atlantic Corp.) from vice-president of Operations & Planning. . . . **James G. Cullen,** SM '81, has left Bell Atlantic Enterprises Corp., where he was president & CEO, to assume the same titles at New Jersey Bell Telephone Co., another Bell Atlantic Corp. subsidiary, in Newark, N.J. . . . **Roger W. Hale,** SM '79, former executive vice-president of Marketing & Business Development at BellSouth Corp. in Atlanta, has become the president & CEO of Louisville Gas & Electric Co. in Kentucky. At BellSouth Enterprises he was responsible for marketing policy, worldwide business development, technology planning and assessment, and international operations. . . . **Donald G. Raymer,** SM '60, retired at the end of July as president & CEO of Central Illinois Public Service Co. in Springfield.

Armen Der Marderosian, SM '75, has been appointed group vice-president and general manager for the newly formed Command, Control, and Communications (C^3) Systems sector of GTE Government Systems Corp. For the past two years he has served as group vice-president and general manager of the company's Tactical Systems sector in Taunton, Mass, which is responsible for the Mobile Subscriber Equipment (MSE) contract, the largest U.S. Army program for tactical communications equipment. In his new position, Der Marderosian will be responsible for the corporation's consolidated tactical and strategic C^3 systems businesses that serve governments, military forces, and commercial organizations worldwide. As vice-president and general manager of GTE Iran in 1980, he directed the GTE contingent in Teheran and organized and led the group's escape from the country when the U.S. embassy was seized. . . . **L. William Miles,** SM '70, received an honorary Doctor of Laws degree last spring from Fairfield University in Connecticut. He is president & CEO of USET, Inc., in Westport, and served 10 years as chairman of the university's board of trustees until stepping down a year ago. . . . Former pitcher **Claude E. (Skip) Lockwood,** SM '83, joined former Red Sox all-star shortstop Rico Petrocelli in kicking off the Greater Dover (N.H.) Chamber of Commerce's Annual Jimmy Fund Breakfast last spring. Lockwood was a major league pitcher for several teams, including the Milwaukee Brewers, the New York Mets, and the Boston Red Sox.

Senior Executives

Raymond F. Pettit, '70, senior vice-president & CFO of the Rockefeller Group, Inc., has been named a director of Apollo Computer, Inc., of Chelmsford, Mass. . . . At Metropolitan Life Insurance Co. in New York, **Harry P. Kamen,** '82, has been promoted to executive vice-president & general counsel from senior vice-president & general counsel.

Richard Dulude, '69, has been elected chairman and CEO of Siecor Corp. He has been the president of Corning's Telecommunications Group, a director of Corning, and a member of its Executive Committee since 1983, and has served since 1957 in various sales marketing, and engineering positions at Corning.

Charles F. Bischoff, Jr., '74, died at his home in West Caldwell, N.J., on April 14, 1989; he was 61. He was a partner and president of the Goodrich & Sherwood Co., a human resources management company in Morristown, N.J. He joined the company 37 years ago as a senior executive vice-president and served as its managing director. He also worked for 23 years with the Allied Signal Corp. until 1986, most recently as staff vice-president of organization and management. He played a major role in more than 50 mergers and acquisitions since 1979, and also had considerable experience in corporate restructuring.

XVI AERONAUTICS AND ASTRONAUTICS

MIT Senior Lecturer **Robert C. Seamans, Jr.,** ScD '51, has been named chairman of the Sea Education Association board of trustees and corporation. The Woods Hole-based association operates two sailing-school vessels, the *Westward* and *Corwith Cramer.* More than 2,000 students from 250 colleges and universities across the country have participated in the SEA programs that combine six weeks of studies ashore in oceanography, maritime studies, and nautical science with six weeks of studies at sea. Prior to his retirement in 1985, Seamans had been the Henry R. Luce Professor of Environment and Public Policy at MIT since 1977, and had served as dean of engineering from 1978 to 1981. He was secretary of the Air Force from 1969 to 1973, and the first administrator of the Energy Research and Development Administration from 1974 to 1977. He was also president of the National Academy of Engineering (1973-74) and associate administrator (1960-65) and deputy administrator (1965-68) of NASA.

MIT Professor of Civil Engineering **Dennis McLaughlin,** PhD '70, has been appointed to the Winslow Career Development Chair for a two-year period.

MIT Associate Professor **Daniel E. Hastings,** PhD '80, has been named to hold the Class of 1956 Career Development Professorship for two years. His teaching and research is in the area of spacecraft-environmental interactions and advanced space propulsion, for which he has developed a new subject. He also teaches rocket propulsion and space gas dynamics. Hastings serves as an advisor to MIT's Second Summer Program and is a member of the advisory board of the Office of Minority Education.

Recently retired from the Department of Aeronautics and Astronautics are Professor **Judson R. Baron,** ScD '56, and Professor **H.H. Theodore Pian,** ScD '48.

The Alumni/ae Association has been notified of the deaths of Vice Adm. **Charles T. Booth,** SM '40, of Greenville, S.C., on February 21, 1989, and Rear Adm. **Denys W. Knoll,** SM '39, of Erie, Penn., on April 12, 1989. No details were provided.

XVII POLITICAL SCIENCE

MIT Political Science Professor **Stephen M.Meyer** was among a group of scholars on the Soviet Union invited to participate in a discussion with President George Bush on East-West relations early in the new administration. The meeting was held at the president's vacation home in Kennebunkport.

XVIII MATHEMATICS

MIT Professor **David J. Benney,** PhD '59, a distinguished applied mathematician whose specialty is fluid mechanics, waves, and stability, has been named to head the Department of Mathematics. He succeeds Professor **Arthur P. Mattuck,** head since 1984, who will return to teaching and research. Benney has been a member of the faculty since 1957, and became a full professor in 1966. He was chairman of the Applied Mathematics Committee from 1983 through 1985. Born in Wellington, New Zealand, Benney received a BS and MS from Victoria University College, New Zealand, and a BA and MA from Cambridge University, England. He has been managing editor for the journal *Studies in Applied Mathematics* since 1969, and has published extensively on nonlinear wave phenomena in fluid flow.

MIT Mathematics Professor **Kenneth M. Hoff-**

man has been appointed executive director of the Mathematical Sciences Education Board of the National Research Council, the operating arm of the National Academy of Sciences. For the past few years, he has been head of the Washington-based Office of Governmental and Public Affairs of the Joint Policy Board for Mathematics, which handles issues and projects of common interest to the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. Hoffman has been on the faculty at MIT since 1956, and will continue as professor. . . . **William H. Barker,** PhD '73, has been promoted to full professor of mathematics at Bowdoin College in Brunswick, Me. He joined the faculty in 1975 as an assistant professor.

John M. Lee, PhD '82, has been awarded one of three Centennial Research Fellowships for 1989-90 from the AMS. He is currently an associate professor of mathematics at the University of Washington. His main research interest is differential geometry, especially applications of partial differential equations to global curvature questions on Riemannian and CR (Cauchy-Riemann) manifolds.

XX APPLIED BIOLOGICAL SCIENCES

MIT Professor of Chemical and Food Engineering **Marcus Karel,** PhD '60, has retired from the active MIT faculty to become State of New Jersey Professor of Food Science at Rutgers University. His continuing association with MIT as professor emeritus will include the supervision of the work of some remaining graduate students. He has been professor of food engineering since 1961, and associate director of MIT's Sea Grant College Program since 1985. Karel's research in freeze drying led to an understanding of operating principles used to preserve flavor of products during freeze drying. Other major areas of research include food dehydration, water relations in foods, and oxidation of liquids. He has won numerous awards and was elected to the Food Engineering Hall of Fame by the journal *Food Engineering*. . . . MIT Professor of Nutritional Biochemistry **Vernon R. Young** has been awarded a Rank Prize of 25,000 pounds sterling (approximately $40,000) for his work on the amino-acid metabolism of man. The Rank Prize Funds recognize and foster significant advances in two areas of science—human and animal nutrition and crop husbandry, and opto-electronics, which explores the interface between the science of optics and the technology of electronics. Both were of particular interest to the late Lord Rank, who established the funds just prior to his death in 1972. Young has won several awards for his research in the application of protein metabolism to clinical nutrition, particularly for his contributions to the understanding of human protein requirements and the influence of aging on protein and amino acid metabolism. . . . **Irene Newsham Gennett,** PhD '89, a genetic toxicologist, has accepted a two-year postdoctoral position at Ludwig Institute for Cancer Research at Royal Victoria Hospital in Montreal.

XXII NUCLEAR ENGINEERING

MIT Professor **Mujid S. Kazimi,** PhD '73, whose teaching and research involves the heat transfer aspects of fission reactor design and safety analysis and the safety implications for fusion technology development, has been named head of the Department of Nuclear Engineering. He succeeds Professor **Neil E. Todreas,** ScD '66, head since 1981. Kazimi has been a member of the faculty since 1976. He was born in Jerusalem, grew up in Jordan, Kuwait, and the West Bank, and came to the United States in 1969 for graduate work at MIT after receiving a BS from Alexandria University in Egypt. He worked at Westinghouse's Advanced Reactor Division and at the Brookhaven National Laboratory before returning to MIT to teach.

Nathaniel D. Woodson, SM '65, is now corporate vice-president & president of international operations at Westinghouse Electric Corp. He was promoted from general manager of the Nuclear Fuel Business Unit. . . . **Andrew C. Kadak,** PhD '72, has advanced from vice-president to president & COO of Yankee Atomic Electric Co., a subsidiary of Central Maine Power Co. in Augusta. He is also a vice-president of another subsidiary, Maine Yankee Atomic Power Co. . . . **Allen G. Croff,** NUE '74, has been named associate director of the Chemical Technology Division and director of the waste management R&D programs at the Department of Energy's Oak Ridge National Laboratory.

Saluting the Founder of System Dynamics

When Jay W. Forrester, SM'45, came to MIT in 1939 to work in electrical engineering, he began a process of discovery that he sees as a continuum, despite the fact that he moved to the MIT School of Management in 1956. Forrester started by using electrical feedback in servomechanisms to produce highly accurate machines that could correct their own mistakes. Then he went on to increase the power and reach of these machines by exploiting ever-larger computers. Finally, he turned the same principles to the goal—still elusive—of making social systems as well understood and well managed as the best mechanical ones.

The 50-year continuum is not ending, but it is winding down: at the age of 70, Forrester retired in July as the Germeshausen Professor of Management and director of the Management School's program in system dynamics, the field of which he is literally the founder.

During Forrester's 33-year tenure in the Management School, system dynamics—the idea that social systems such as companies, cities, and even national economies behave in counter-intuitive ways because of the power of inherent but often unrecognized feedback loops—has grown from a vision to a full-fledged discipline.

Applications of system dynamics to the behavior of companies came first, pioneered in the 1950s as "industrial dynamics." They're still the basic structure on which other applications rest, said Henry Weil, '64, president of Pugh-Roberts Associates, at a symposium in Forrester's honor in May.

Professor Dennis Meadows, PhD'69, who directs the University of New Hampshire's new Institute for Social Policy Research, has been involved in public-sector applications of system dynamics ever since he was catapulted into a world spotlight by the success of his book *Limits to Growth,* which is based on his MIT thesis work. Now his hope, he said, is to use gaming based on system models as a tool for education and analysis at state and local levels.

As president of High Performance Systems, Barry Richmond, PhD'79, is taking system dynamics further into education by introducing systems thinking and modeling into elementary and junior high schools in Tucson, Ariz. The classes, he said, are becoming "electronic playgrounds" where students and teacher interact with a model. Space is compressed, time made faster, global issues are comprehensible, invisible changes made visible. Forrester's contribution, said Richmond, has been to make transparent the dynamics of the systems around us.

Richmond paid tribute to the interest of Gordon S. Brown, '31, former dean of engineering who was director of the MIT Servomechanisms Laboratory when Forrester joined it and who is now retired in Tucson. Later, Forrester paid an even higher tribute to Brown as his greatest MIT mentor: Brown is "behind everything that has been talked about today," he said at the symposium.

Furthermore, Forrester said, "the real future of this field lies at the level of elementary and secondary schools. A baby is born with an inherent sense of causes and effects—dynamics. But school structures stamp out this interest by emphasizing statics." To right this wrong, said Forrester, a new fund named in honor of Brown will "support systems thinking in primary and secondary schools." Already more than $200,000 has been pledged.

To honor Forrester, the MIT School of Management will put his name on a new lecture-seminar room and on a new fund that will support system dynamics research. Thomas J. Watson, Jr., former president and chairman of IBM, has given MIT funds for a Jay Wright Forrester Professorship. Forrester himself will continue teaching and research at MIT, while John D. Sterman, PhD '82, now heads the Management School's program in system dynamics.—*John Mattill* □

John T. Norton, 1898-1989

At MIT, we have great scientists and engineers, and John Norton was one, but he was the only gentleman I ever met," said his thesis advisee and colleague Robert Ogilvie, ScD, '55. Indeed, that is the word that everyone uses when describing the late Professor John T. Norton, who died July 18 of heart disease at age 90: "He was a gentleman and a *gentle man*," said Marge Meyer, a longtime secretary in the Department of Materials Science and Engineering.

Norton was professor of physics of metals, and his 43-year career at MIT was part of a family tradition of service to the Institute that spanned three quarters of a century. Most recently, he was chairman of the board of AMRAY, a company he cofounded in 1961 that is now the nation's largest producer of scanning electron microscopes.

John Norton was born in Medford, Mass., in 1898, the son of Professor Charles L. Norton, '93, who headed the MIT Physics Department for many years. John Norton's brother, Frederick H. Norton, '18, now deceased, was a member of the Department of Metallurgy for 35 years and an authority on ceramics.

John Norton's place in this dynasty began as an undergraduate at MIT. He graduated with an SB in 1918 and an ScD in 1933. He became a research associate in 1920 and had risen to full professor of metallurgy by 1941, just in time for World War II. Norton studied stresses on the welded plate armor that was used in navy ships and aircraft castings. He used X-rays to study three-dimensional internal stress patterns to detect flaws. After the war, he pursued his interests in the physics of metals.

"He helped the department get started on a more scientific track," said his colleague Morris Cohen, '33. "X-rays really extended the limits of what we knew [about metals]. John in his quiet way really enriched the field."

As a member of the scientific advisory board of the Boston Museum of Fine Arts, Norton used X-ray diffraction and X-ray fluorescence to judge the authenticity of antiquities. He also studied new stronger alloys produced by the compression of powdered metals, and in 1961 was the first American to be awarded the Plansee Plaque for fundamental contributions to the field of powder metallurgy.

Norton was chairman of the MIT faculty from 1956-58, and in 1961 he became acting dean of the graduate school. He was concerned about the graduate experience at MIT, wanting to minimize the associated trauma. He believed that graduate students, rather than being narrow and focused, ought to be able to study humanities along with technology.

Norton also had a strong interest in study abroad, according to Dorothy Bow, at one time his secretary: "He thought it was one of the most wonderful things." Norton himself traveled abroad nearly every year, and in 1963, President Julius Stratton, '23, appointed him to the new office of foreign study advisor. Norton worked to establish policies that permitted students studying abroad to be eligible for financial aid, just as if they were studying on campus.

In 1964, Norton retired from the faculty to become president of AMRAY, serving in that capacity until 1973. He continued to take an active role in the company until his death.—*James Walsh* □

The author is a junior at Harvard College and was a summer intern at Technology Review.

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review*'s last deadline:

Elwyn E. Snyder, '14; July 18, 1989; Chatham, Mass.
Edward F. Hewins, '16; 1982; Hampton, Va.
John T. Norton, '18; July 18, 1989; Cambridge, Mass.
Robert Insley, '19; October 28, 1987; Detroit, Mich.
Malcolm B. Lees, '20; April 1988; Allendale, N.J.
Frank H. Coldwell, ;21; June 5, 1989; Port Edwards, Wisc.
Ernest R. Gordon, '21; March 23, 1989; Denver, Col.
Joseph C. Moosbrugger, '21; June 20, 1989; Rockville Centre, N.Y.
Perry R. Taylor, '21; November 2, 1987; Arlington, Va.
William H. Lang, '22; May 27, 1989; Saint Paul, Minn.
Howard B. Sloan, '22; June 28, 1989; Cape Elizabeth, Maine.
Harold F. Crotty, '23; June 30, 1989; Dover, N.H.
Philip Schwartz, '23; June 15, 1989; Pasadena, Calif.
Oaklee E. Charlton, '24; May 12, 1989; Tallahassee, Fla.
William H. Layton, '24; September 18, 1988; New York, N.Y.
Charles S. Stodter, '24; October 29, 1988; Fair Haven, N.J.
Mrs. John E. Kennedy, '25; June 4, 1989; Boston, Mass.
Richard W. Carlisle, '26; December 12, 1988; Ogdensburg, N.Y.
William H. Hamilton, '26; May 1, 1989; Clarksboro, N.J.
Robert W. Rogers, '26; June 4, 1989; Barrington, R.I.
Leo J. Myskowski, '28; July 8, 1989; Stoneham, Mass.
J Palmer Boggs, '30; June 12, 1987; Missoula, Mont.
Maurice L. Sellers, '31; May 3, 1989; Williamsburg, Va.
Charles A. Fenno, Jr. '32; June 22, 1989; Cincinnati, Ohio.
George L. Green, '32; June 19, 1989; Bristol, R.I.
William C. Sprenger, '32; April 16, 1989; Port Townsend, Wash.
Newton W. Buerger, '33; June 4, 1988; Carmel, Calif.
George E. Hughes, '33; May 9, 1989; Colorado Springs, Col.
Charles W. Bechle, '34; November 18, 1988; Sycamore, Ill.
Joseph A. Drankowski, '34; May 19, 1989; San Carlos, Calif.
David D. Knox, '34; May 31, 1989; Stonington, Conn.
Reginald G. Murdoch, '34; May 14, 1989; Laconia, N.H.
Henry A. Wood, '34; 1989; Pico Rivera, Calif.
George W. Bartlett, '35; June 12, 1989; Centerville, Mass.
Laurence F. Cleveland, '35; July 16, 1989; Newtonville, Mass.
Richard H. Farmer, '36; June 4, 1989; Marco Island, Fla.
Paul B. Black, '38; June 30, 1989; Damariscotta, Maine.
John C. Carter, '39; 1969.
William M. Postman, '39; September 15, 1988; Anderson, S.C.
Frederick Lange, '40; May 30, 1989; Absecon, N.J.
John D. Briggs, '42; June 13, 1989; Bethlehem, Penn.
Howard R. Spendelow, Jr., '42; 1987; Medford, N.J.
Robert M. Lambert, '48; June 18, 1988; Plainfield, N.J.
Herman T. Cook, Jr., '50; April 9, 1989; Levittown, N.Y.
David S. Turnbull, '51; October 17, 1989; Sparks Glencoe, Md.
Charles L. Stockdale, '52; June 9, 1989; South Yarmouth, Mass.
Richard Snyder, '51; May 28, 1989; Blue Hills, Maine.
Alan L. Friedman, '53; June 27, 1988; Wilmington, Mass.
Martin Gilvar, '55; June 12, 1989; Oakham, Mass.
John A. Brown, Jr. '57; July 16, 1987; Waldorf, Md.
Howard L. Yudkin, '59; May 23, 1989; Rockville, Md.
Terry A. Welch, '60; November 22, 1988; Austin, Tex.
Philip I. Bachelder, '67; May 24, 1989; Irvine, Calif.
Steven E. Yelick, '80; November 30, 1988; Brookline, Mass.
Paul E. McKenzie, '90; June 17, 1989; Cambridge, Mass.

ALLAN J. GOTTLIEB, '67

Canceled Checks

Since this is the first issue of a new academic year, I once more review the ground rules under which this department is conducted.

In each issue I present five regular problems (the first of which is chess, bridge, or computer-related) and two "speed" problems. Readers are invited to submit solutions to the regular problems, and three issues later, one submitted solution is printed for each problem; I also list other readers whose solutions were successful. For example, solutions to the problems you see below will appear in the February/March issue. Since I must submit that column sometime in November, you should send your solutions to me during the next few weeks. Late solutions, as well as comments on published solutions, are acknowledged in the section "Better Late Than Never" in subsequent issues.

For speed problems the procedure is quite different. Often whimsical, these problems should not be taken too seriously. If the proposer submits a solution with the problem, that solution appears at the end of the same column in which the problem is published. For example, the solutions to this issue's speed problems are given below. Only rarely are comments on speed problems published or acknowledged.

There is also an annual problem, published in the first issue of each new year; and sometimes I go back into history to republish problems that remained unsolved after their first appearance.

Problems

OCT 1. The market may be speaking. This month we are scheduled to begin with a chess problem but none have been submitted and we will begin instead with a bridge problem from Tom Harriman. If you would like to see chess problems, please submit them!

NORTH
♠ A J 7 5
♥ A Q 7 4 2
♦ A J
♣ 5 4

WEST
♠ 8 6
♥ 10 8 2
♦ 10 8 7 5 3
♣ 9 8 7

EAST
♠ Q 10 9 2
♥ K 9 6
♦ K Q 6 4 2
♣ 10

SOUTH
♠ K 4 3
♥ J 5
♦ 9
♣ A K Q J 6 3 2

How does South play to make seven clubs against best defense after the opening lead of the spade 8?

OCT 2. Gordon Rice supposes that some time in the (not too distant?) future, the art of pencil-and-paper arithmetic has been forgotten. Also, your computer is giving off smoke. With no way to add, subtract, multiply, or divide except an eight-digit calculator, can you evaluate the following expressions?

$3 \cdot 180997^2 - 313496^2$

$3 \cdot 37467^2 - 64896^2$

OCT 3. John Rule has a three-digit number that, when divided by the product of its digits, yields as quotient the hundredth digit. Rule wants you to find this number and show that it is unique.

OCT 4. David Evans notes that on an 8×8 checkerboard, if two squares of the same color are removed, it is impossible to cover the remaining 62 squares with 31 1×2 tiles (since each tile covers one white and one black square). Is the converse true, i.e., if you remove 2 squares of opposite colors, can the remaining 62 squares always be covered by 31 1×2 tiles?

OCT 5. Chuck Coltharp poses the following partitioning question. Let S be a finite set of size 4n and let P be a collection of partitions of S, each of which partitions S into two disjoint sets of size 2n. Let the ith partition be the two sets A_i and B_i. We require that, for $i \neq j$, $A_i \cap B_j$ is of size n. The question is how large can P be, that is, for each n what is the largest number of partitions that can be found satisfying the above properties?

SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012.

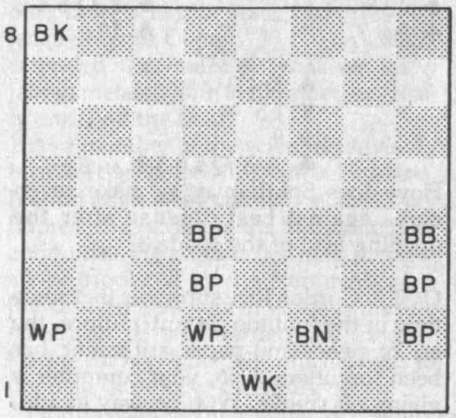
Speed Department

SD 1. Jim Landau wants two non-identical functions f(x) and g(x) such that $\int f(x)dx = g(x)$ and $\int g(x)dx = f(x)$.

SD 2. Edward Wallner notes that both William Shakespeare and Miguel Cervantes died on April 23, 1616, and asks who died first?

Solutions

M/J 1. We begin with a two-part chess problem that appeared in *The Tech* during 1984. First, in the figure below, find a helpmate in 7, i.e., black moves first and cooperates with white so that black is mated on white's 7th move. Second, solve the same problem with the bishop on H4 gone.



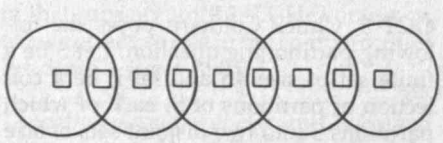
According to Richard Hess, the key to this problem is not to promote all pawns to queens. Hess's solution is:

A:	black	white
(1)	b-e7	p-a3
(2)	n-e4	k-f2
(3)	b-b4	Pxb
(4)	n-c5	Pxn
(5)	p-hl(r)	P-c6
(6)	r-a1	P-c7
(7)	r-a7	P-c8(Q) mate

B:	black	white
(1)	k-b7	P-a4
(2)	k-c6	P-a5
(3)	k-d5	P-a6
(4)	k-e4	P-a7
(5)	k-f3	P-a8(R)
(6)	k-g2	R-a1
(7)	k-h1	Kxn mate

Also solved by Robert Bart, Matthew Fountain, Winslow Hartford, and James Walker.

M/J 2. Nob. Yoshigahara wants you to put a unique digit from 1 to 9 in each of the nine boxes so that the sums in the circles are all equal.



Please paste in figure from M/J

Gordon Rice was able to solve this without a computer-assisted search; his solution follows:

We require that the nine numbers A, B, C, D, E, F, G, H, and I, representing a permutation of 1, 2, . . ., 9, satisfy, for a given sum S, the equations:

$$\begin{aligned} A + B &= S \\ B + C + D &= S \\ D + E + F &= S \\ F + G + H &= S \\ H + I &= S. \end{aligned}$$

We note that

$$A + 2B + C + 2D + E + 2F + G + 2H + I = 5S$$

$$A + B + C + D + E + F + G + H + I = 45$$

so

$$B + D + F + H = 5(S - 9).$$

Let us call a set of values for B, D, F, and H (ignoring the order of assignment) an "overlap set". There are 26 possible overlap sets:

S = 11	S = 12	S = 13	S = 14	S = 15
1,2,3,4	1,2,3,9 x	1,2,8,9	1,7,8,9	6,7,8,9 x
	1,2,4,8 x	1,3,7,9	2,6,8,9 x	
	1,2,5,7 x	1,4,6,9 x	3,5,8,9 x	
	1,3,4,7	1,4,7,8	3,6,7,9	
	1,3,5,6	1,5,6,8 x	4,5,7,9 x	
	2,3,4,6	2,3,6,9	4,6,7,8 x	
		2,3,7,8		
		2,4,5,9 x		
		2,4,6,8		
		2,5,6,7 x		
		3,4,5,8 x		
		3,4,6,7 x		

The 14 overlap sets marked with an "x" may be eliminated by the rule that if two members of the overlap set add up to S, no solution is possible. We establish this rule as follows.

The numbers chosen for B and H must be in the overlap set; the numbers chosen for A and I must not. If two numbers in the overlap set add up to S, then they are both unavailable for B or H. That leaves two remaining. But at least one is too small (i.e., less than S − 9). The exception is S = 15, but there both pairs of the overlap set add up to S.

That leaves 12 to try. We avoid symmetries by requiring that A be less than I. "x" marks the point at which a trial fails.

S	set	A	B	C	D	E	F	G	H	I	
11	1,2,3,4	7	4	6	1	8	2	x			
		7	4	5	2	8	1	x			
		7	4	5	2	6	3	x			
		8	3	7	1	6	4	5	2	9	solution
		8	3	6	2	5	4	x			
12	1,3,4,7	5	7	2	3	8	1	x			
		8	4	5	3	2	7	x			
	1,3,5,6	7	5	4	3	8	1	x			
	2,3,4,6	8	4	5	3	7	2	x			
13	1,2,8,9	4	9	3	1	x					
		5	8	4	1	3	9	x			
		5	8	3	2	x					
	1,3,7,9	4	9	x							
		6	7	5	1	x					
	1,4,7,8	5	8	x							
		6	7	5	1	x					
		6	7	2	4	x					
	2,3,6,9	4	9	1	3	8	2	5	6	7	solution
	2,3,7,8	5	8	x							
		6	7	4	2	x					
	2,4,6,8	5	8	1	4	7	2	x			
		5	8	1	4	3	6	x			
		5	8	3	2	7	4	x			
		7	6	5	2	3	8	1	4	9	solution
		7	6	3	4	1	8	x			
14	1,7,8,9	5	9	4	1	6	7	x			
		6	8	5	1	4	9	x			
	3,6,7,9	5	9	2	3	4	7	1	6	8	solution

Also solved by Jonathon Aronson, Robert Bart, Michael Baumann, Larry Bell, John Chandler, Walter Cluett, John Cushnie, Steve Feldman, Bridget Fitzpatrick, Matthew Fountain, Emil Frei, Jim Gawn, Thomas Harriman, Winslow Hartford, Richard Hess, Linda Kalver, T. Landale, Warren Legler, Samuel Levitin, Mary Lindenberg, Edward Martin, Robert Massard, Frank Model, Paul Ness, Walter Nissen, Gardner Perry, Steve Peters, Ron Raines, Michael Riezenman, Lorenzo Sadun, Thomas Sico, Alan Taylor, James Walker, Don Warren, Meredith Warshaw, Kelly Woods, Harry Zaremba, and the proposer.

M/J 3. Thomas Murley asks, for a random physical constant, what is the probability that its *second* digit is N?

The following solution is from John Chandler: The probability density function of the second digit of a random constant is biased in the same way as that of the first, only not so strongly. I assert that the phrase "random physical constant" means just that the log of the constant has a uniform distribution, and I believe that assertion must be considered an axiom (which might not be true—remember, Dirac's "large number hypothesis" holds that large physical constants are all the same!). Thus, just as the probability that the first digit is N is given by log N + 1/N, the probability that the second is N is given by

$$p(N) = \log\left(\frac{11+N}{10+N}\right) + \log\left(\frac{21+N}{20+N}\right) + \log\left(\frac{31+N}{30+N}\right) + \ldots + \log\left(\frac{91+N}{90+N}\right)$$

In other words, the probability that the second digit is, say, 2 is the sum of the probabilities that the first TWO digits are 12, 22, 32, 42, 52, 62, 72, 82, and 92. It is easy to show that base-ten logs give the proper normalization for the probability density, since the sum of all the individual terms of p(0) through p(9) is just log 100/10.

The following is a table of p(N).

N	p(N)
0	0.11967927
1	0.11389010
2	0.10882150
3	0.10432956
4	0.10030820
5	0.09667724
6	0.09337474
7	0.09035199
8	0.08757005
9	0.08499735

Also solved by Jonathon Aronson, Matthew Fountain, Thomas Harriman, Winslow Hartford, Richard Hess, Meredith Warshaw, and the proposer.

M/J 4. Robert Bart extends a problem posed last year and asks for the smallest positive integer A_i such that $(A_i)^{1/i}$ begins with 10 distinct digits. Note that A_1 = 1023456789 (leading zeros are not permitted) and that we established A_2 = 1362 last year ($1362^{1/2}$ = 36.90528417 . . .). Mr. Bart specifically asks for A_3 through A_{10}.

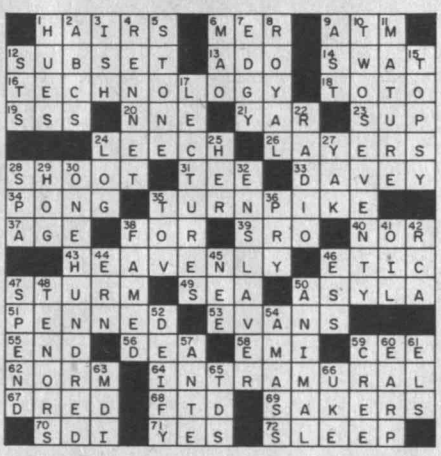
The following solution is from Michael Baumann: This clearly calls for a computer program to go about its merry way, starting at A_i = 1 and checking the result until the desired result is obtained. The puzzle asked for values for A_i for i = 3, . . ., 10, but I figured once you got the program running why stop at ten. I propose the following solutions:

i	A_i	$(A_i)^{1/i}$
2	1362	36.90528417
3	2017	12.63480793
4	6654	9.031724865
5	911	3.907542186
6	319	2.613957048
7	6702	3.520469871
8	4954	2.896473105
9	5496	2.603518974
10	9213	2.491380765
11	402	1.724836059
12	1644	1.853496702
13	1813	1.780926453
14	2059	1.724605389
15	2687	1.692847530
16	4020	1.679825340
17	679	1.467508329
18	108	1.297083654
19	540	1.392548076
20	1396	1.436297058
21	4668	1.495273086
22	128	1.246758309
23	6552	1.465309278
24	2546	1.386470925
25	1168	1.326470859
26	386	1.257430896
27	3349	1.350679824
28	6363	1.367240985
29	900	1.264359078
30	4920	1.327594680
31	980	1.248795036
32	377	1.203678954
33	4072	1.286435790
34	5825	1.290458367
35	700	1.205836749
36	1967	1.234509867
37	979	1.204569783
38	10796	1.276845930
39	4081	1.237609854
40	4653	1.235074986

Also solved by Larry Bell, Steve Feldman, Matthew Fountain, Winslow Hartford, Richard Hess, and Harry Zaremba.

M/J 5. Our last regular problem is not that regular; it is a crossword puzzle from Andrew Greene published last year in *The Tech*. I have no objection to including these kinds of problems but want to know what *you* think.

Our last solution is from Larry Bell:



As for the feedback you requested, I must say that although I don't consider myself a true crossword afficionado, I really did enjoy doing this one. The best part about it is the clues that are directed towards the "tech-minded" individual (e.g., me). Appropriate topics for crossword clues also include (my opinion): campus trivia, current "high tech" events, Star Trek, items from prior *Tech Review* articles, programming language keywords or concepts, etc.

Also solved by R. Alexander, John Chandler, Steve Feldman, Bridget Fitzpatrick, Winslow Hartford, Richard Hess, Warren Legler, Thomas Lewis, Frank Model, Gardner Perry, Thomas Sico, Alan Taylor, James Walker, Don Warren, Meredith Warshaw, Harry Zaremba.

Better Late Than Never

JAN 3. Harry Zaremba now believes that the length of the rectangle can be reduced to 165.5.

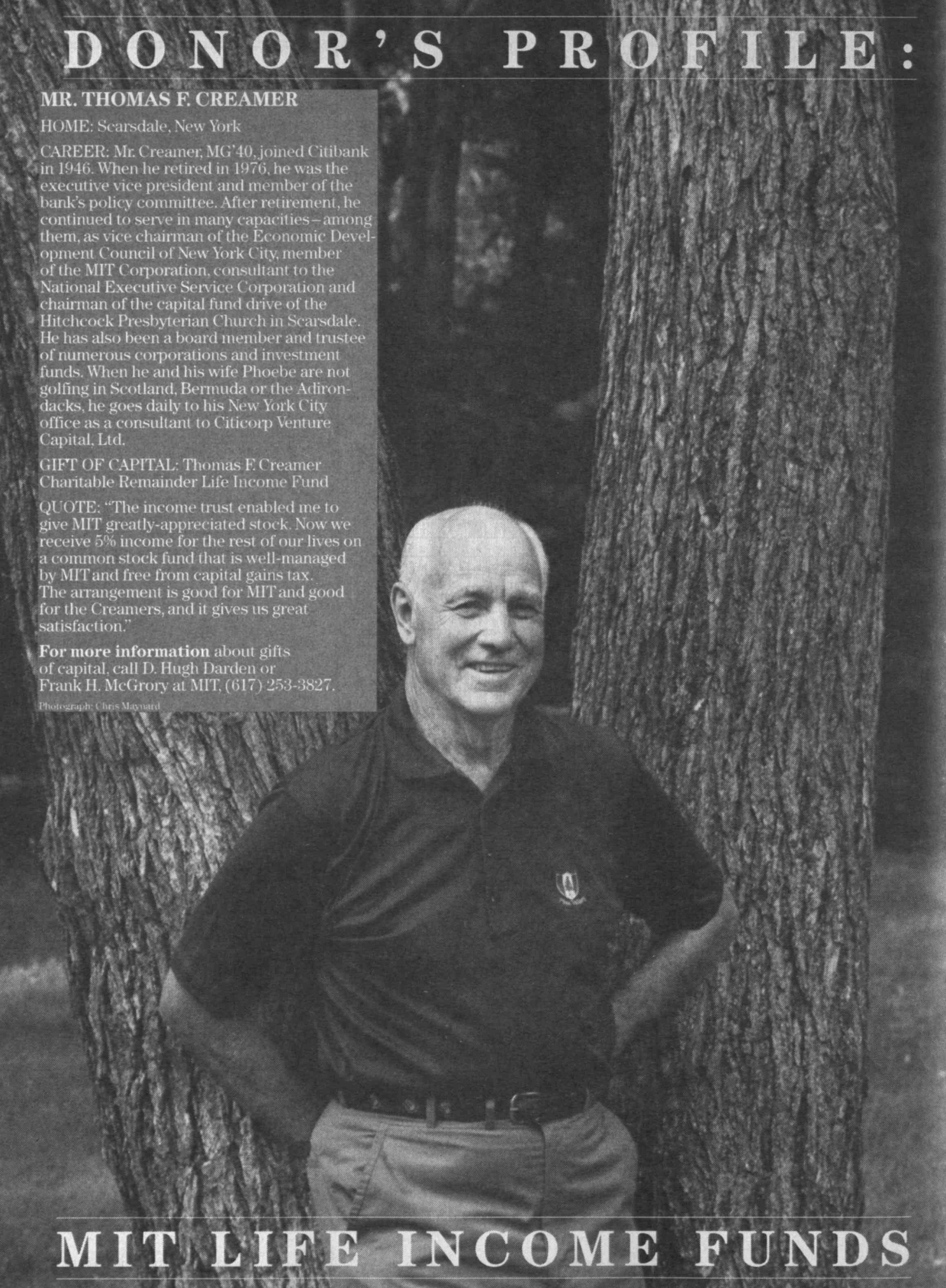
M/J SD1. Robert Bishop, Stephen Rawlinson, and Lorenzo Sadun note that 1900 was not a leap year according to the Gregorian calendar. Rawlinson suggests that perhaps the Julian calendar was being used and Bishop favors the conjecture that Frederic and W.S. Gilbert shared the widespread ignorance about the special status of 1900.

Proposers' Solutions To Speed Problems

SD 1. $-e^{-x}$ and e^{-x}

SD 2. Cervantes. Spain was using the Gregorian calendar and England the Julian.

DONOR'S PROFILE:



MR. THOMAS F. CREAMER

HOME: Scarsdale, New York

CAREER: Mr. Creamer, MG'40, joined Citibank in 1946. When he retired in 1976, he was the executive vice president and member of the bank's policy committee. After retirement, he continued to serve in many capacities – among them, as vice chairman of the Economic Development Council of New York City, member of the MIT Corporation, consultant to the National Executive Service Corporation and chairman of the capital fund drive of the Hitchcock Presbyterian Church in Scarsdale. He has also been a board member and trustee of numerous corporations and investment funds. When he and his wife Phoebe are not golfing in Scotland, Bermuda or the Adirondacks, he goes daily to his New York City office as a consultant to Citicorp Venture Capital, Ltd.

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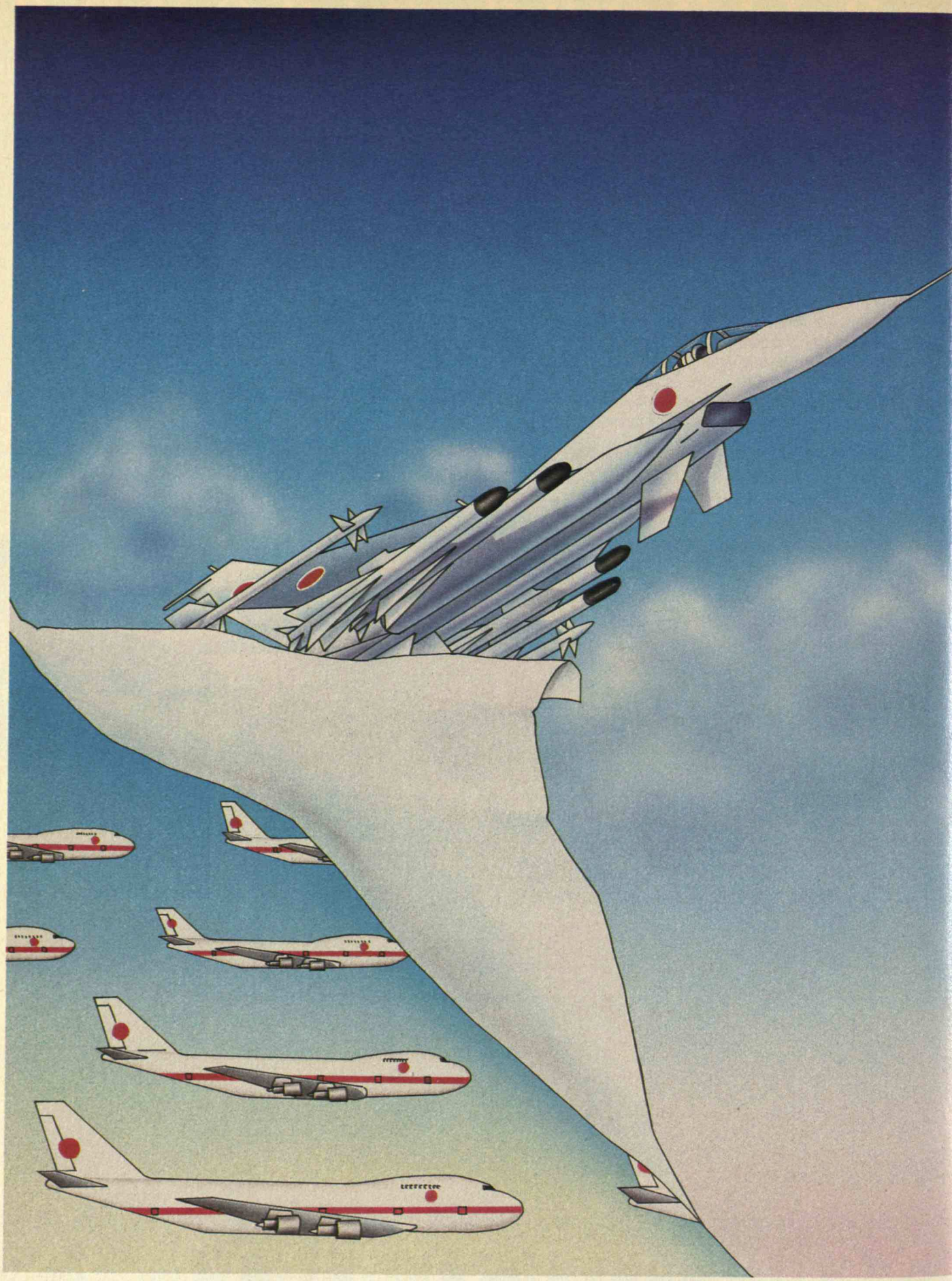

The FSX and Japan's Strategy for Aerospace

After a 40-year preoccupation with commercial economic development, Japan is now expanding defense production to compete effectively in aerospace.

BY RICHARD J. SAMUELS AND BENJAMIN C. WHIPPLE

The Senate's decision last May to allow joint U.S.-Japanese development and production of the FSX, a new jet fighter for the Japanese air force, culminated two years of often bitter debate in Washington and Tokyo. The controversial agreement acknowledges Japan's new status as a technological power of the first rank and establishes new rules for a two-way flow of technology. Japan will lead the project, taking on roughly 60 percent of development and production. In exchange for access to sophisticated American aerospace technology, the Japanese will share any improvements they make, as well as negotiate licenses for any of their own technology used in the program. In effect, the United States is betting that Japanese firms can enhance U.S. military aerospace technology with their expertise in commercial electronics, materials, and manufacturing.

Japanese policymakers see military aerospace and the FSX project in particular as essential to developing a civilian aerospace industry. They look to aerospace to revitalize Japan's heavy industrial sector and spread the benefits of high technology throughout the economy. They believe that aerospace manufacturing has close ties to the machinery, housing, automotive, leisure, and service industries, and commonly compare it to a tree whose "roots'

ILLUSTRATIONS: MICHAEL MCGURL PHOTO RESEARCH: JAMES P. WALSH

Developed in the late 1950s, the YS-11 (near right) remains the only indigenous Japanese commercial aircraft. It was a technological success but a failure in the marketplace. More recently, a consortium of Japanese aerospace firms assumed full responsibility for part of the Boeing 767 (center). But Boeing canceled the 7J7 (far right), a follow-up to the 767 in which the Japanese consortium was to have played a larger role.

(process technologies) and "fruits" (products) will sustain Japan into the twenty-first century.

Like steel, machinery, and electronics before it, the civilian aerospace industry in Japan has received extensive government support—as much as computer research, and more than telecommunications and energy. However, aerospace is unique in one crucial respect: in all nations where the industry has flourished, it has been created and sustained by military air and space programs, not by commercial markets for civilian products. Commercial aviation is a large and expanding business, but demand for commercial aircraft alone cannot sustain the development of an aerospace manufacturing base. So, Japan, like other nations, hopes to "spin off" technology, manufacturing plants, and a skilled work force from military to civilian aerospace.

But there is another reason why Japan is interested in the military side of the aerospace industry. Both domestic and foreign military aerospace markets—for components and sub-systems, if not entire aircraft—offer Japanese firms the opportunity to profit further from technologies they originally developed for civilian purposes. The continuing transformation of the aerospace industry from bending metal to integrating advanced technologies has focused attention on fields in which Japan has growing strength: materials, microelectronics, computers, telecommunications, and high technology in general. These "dual-use" technologies are now vital to all Western military aerospace industries; indeed, the Japanese point out that American warplanes could not fly without Japanese components. They call this process of moving technology from civilian to military markets "spin-on," in contrast to spin-off.

Anxious to capitalize on these new opportunities, frustrated in their attempts to create a non-military aircraft industry, and continually pressured by the United States to rearm more vigorously, Japan in the 1980s has turned to military spending as a mechanism for developing an aerospace industry. Although revitalization of the defense industry remains controversial both domestically and in Japan's relationship with the United States, it has emerged as a versatile and effective strategy backed by a broad political coalition. The groundbreaking agreement to co-develop rather than co-produce or import the FSX raises the platform from which Japan's fledgling aerospace industry will lift off into the sphere of international competition.

The Japanese Failure in Commercial Aerospace

Aerospace emerged from an alliance forged during World War II among the military, the scientific community, and the aviation, electronics, and instrumentation industries. Military production remains the backbone of the industry. Only 4 of the 29 jet transports ever built in the West have broken even financially; the Boeing Corp., maker of all four, has only recently begun to profit from commercial production after 30 years of investment and military support. American aerospace, by far the world's largest, most diversified and commercialized national industry, typically sells over 60 percent of its output to the Department of Defense. A significant fraction of the remainder goes to other government agencies and foreign militaries. The Japanese Defense Agency (JDA) procures over 80 percent of Japanese output, in a market where the largest domestic producer of jet engines has never sold one for commercial use.

Until the end of World War II, the military presided over Japan's large and technically advanced aircraft sector. As late as 1944, there were twelve independent airframe producers and seven engine manufacturers. The demilitarization of Japan in the postwar years devastated the industry. The U.S. Occupation banned all aircraft manufacturing and broke up the major

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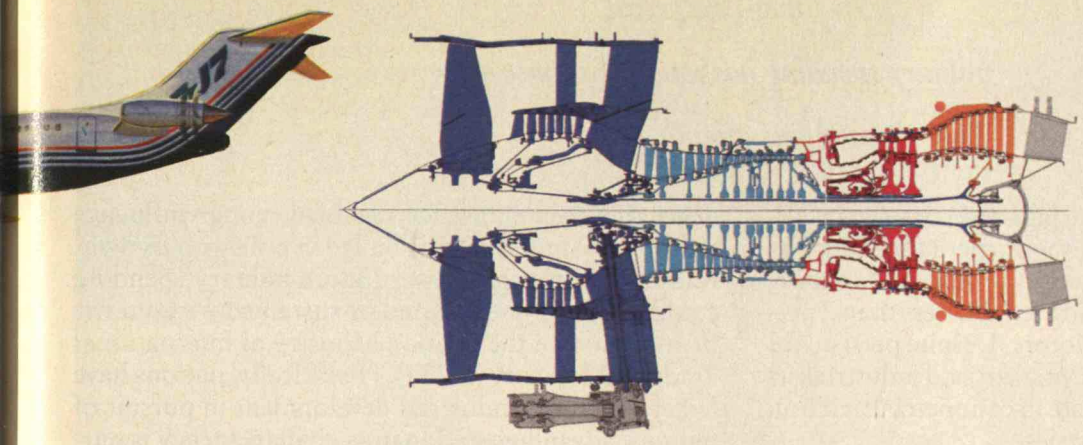
RICHARD J. SAMUELS is associate professor of political science at MIT and director of the MIT Japan Program. His book, The Business of the Japanese State *(Cornell, 1987), won the Masayoshi Ohira Memorial Prize in 1988. BENJAMIN C. WHIPPLE is a doctoral student at MIT's Sloan School of Management. He began studying the aerospace industry as an undergraduate at Swarthmore College, where he graduated in history and political science in 1978. A longer version of this article appeared in* Politics and Productivity: How Japan's Development Strategy Works, *edited by Chalmers Johnson, Laura Tyson, and John Zysman (Ballinger, 1989).*

PHOTO: MITSUBISHI HEAVY INDUSTRIES



Japanese aerospace companies participated in a five-nation consortium that produced the V2500 turbofan engine. The dark blue area of the cross-section at left shows the portions that the Japanese firms designed and assembled—the fan, the low-pressure compressor, and parts of the high-pressure compressor and turbine. However, the V2500 has been plagued by technical difficulties, and future profits are unlikely.

manufacturers into smaller, less threatening enterprises. When the ban was lifted after seven years, the rest of the world had entered the jet age, while the thinning ranks of Japanese aircraft engineers were designing bicycles and fire extinguishers.

Despite a protracted domestic debate over the merits of defense production in the mid 1950s, and nominal rearmament starting in 1954, the military has played a trivial role in the postwar Japanese economy. Beginning in the mid-1960s, the government limited defense spending to 1 percent of GNP and barred the export of arms and weapons technology. While these constraints have contributed to Japan's overall commercial competitiveness, they have undermined its efforts to create a viable aerospace industry.

Japan's planners have tried repeatedly to participate in the postwar commercial aircraft business. Their first effort was the YS-11 project, initiated in 1957, to design and produce Japan's first and so far only indigenous commercial aircraft. All of the country's heavy industrial and related components manufacturers participated in the project through a consortium in which the state assumed 50 percent of the equity and paid the development costs. The formula offered little incentive for market analysis or cost reduction. While the YS-11 aircraft was proclaimed a technological success, fewer than 200 planes were sold, two-thirds of them to domestic airlines that would have bought more had it not been for severe production delays. The program ultimately suffered losses equal to four times its capitalization; when it wound down in the early 1970s, the planners withdrew to consider less ambitious strategies for developing a commercial aircraft industry.

By 1980, government and industry had swapped the policy of indigenous development for one based on international collaboration. Japanese firms allied themselves with Boeing and with the International Aero Engines (IAE) consortium led by Rolls-Royce of Britain and the Pratt and Whitney division of the U.S. firm United Technologies.

The Japanese used Boeing's concerns about high development costs and competition from Airbus Industries to gain limited access to the expertise in design and systems integration of the world leader in commercial aircraft. A consortium of Japanese firms became a junior partner, with full financial responsibility for developing and producing fuselage components for the Boeing 767, about 15 percent of the aircraft. The agreement with Boeing gave the consortium hopes for an even greater role in developing a follow-up to the 767. The 7J7—with the "J" standing for Japan—was to be an all-new-technology aircraft, and the Japanese consortium was to be an equal partner in all aspects of design and production.

The alliance with Boeing, however, has been disappointing. In response to slow sales of the 767, Japanese firms have stretched out production, increasing unit costs. As the value of the yen has risen, dollar-denominated contracts have forced these companies to supply parts at a loss. To make matters worse, the crown jewel of the collaboration was snatched away in late 1987, when Boeing cancelled the 7J7. Boeing and the Japanese consortium are now discussing less ambitious projects, including a "stretched" version of the 767. Meanwhile, European firms seem to have the inside track as partners with the Japanese consortium on its next project—a 75-seat transport.

Technical and organizational problems at the IAE consortium have also created difficulties for junior-partner Japanese manufacturers. IAE's V2500 engine, intended as a power plant for 150-seat transports such as the Airbus A320 and the ill-fated 7J7, repeatedly failed development tests, and IAE compounded its problems with marketing gaffes. Costly delays, tough competition from another international alliance between General Electric and the French aerospace firm Snecma, and the awkwardness of a five-nation consortium with two leaders have made V2500 sales elusive and future profits improbable.

Between the troubles at IAE and the demise of Boeing's 7J7, the collaborative strategy once intended to drive Japan's commercial aerospace into the next century appears little more satisfactory than the autonomous approach of the YS-11 era. Even after a decade

PHOTOS: BOEING COMMERCIAL AIRPLANES ILLUSTRATION: INTERNATIONAL AEROENGINES

In Japan, increased military spending has made aerospace a prestigious growth sector.

of subsidized cooperation, the Japanese commercial aircraft business is only about one-fortieth the size of its American counterpart. The total value of Japanese commercial aircraft production remains less than 2 percent of the sales of Toyota Motors. Despite persistence and flexibility, Japanese policymakers and industrialists have proved unable to replicate in commercial aviation their success in other industries.

Defense Production for Aerospace Development

Japan's failure to develop commercial aerospace is often attributed to a long list of adverse industrial conditions: a small domestic market, the strong position of Western suppliers, the ban on military exports, and a lack of experience with aircraft design, systems integration, and international sales and support. But the fundamental problems—and their solutions—have stemmed less from the market than from political forces flowing from Japanese attitudes about how much and how best to provide for national security.

Postwar Japan has traditionally gauged its security by industrial strength rather than military power. In the 1980s, however, a recalculation of the country's military and industrial strategies has prompted a dramatic increase in defense production. Over the past decade, a period of austerity for other government agencies, Japan's defense budget and the fraction spent on aerospace have grown steadily. The ban on weapons exports, always open to interpretation, has become less strict. Japan sells significant volumes of dual-use materials and components, as well as some vehicles, to military contractors abroad.

Despite the 1-percent-of-GNP cap, which ended with the fiscal 1988 budget, Japan's robust economic growth has allowed it to support a military buildup that has already spanned several administrations. Japan now ranks third in the world in military spending. Sustained higher defense spending has turned aerospace into an important and prestigious growth sector. At Mitsubishi Heavy Industries, Japan's largest defense contractor, aerospace sales grew by 50 percent between 1983 and 1985; this growth catapulted the business from last to second place among the firm's seven divisions. Nearly 200 firms overall have benefited from increased funding for military aerospace.

Nonetheless, considerable antipathy toward the military remains firmly embedded in Japanese society, and the pacifist legacy of World War II has provided a novel background to the military buildup. There is no evidence that the military has regained enough influence to bring about the recent change in policy on its own. Rather, Japan's shift toward more military spending could not have been started or sustained without the firm support of the nation's Ministry of International Trade and Industry (MITI). Historically, nations have fostered civilian industrial development in pursuit of military advantage; in Japan, a civilian agency is pursuing military production for commercial advantage.

MITI's officials have always been aware of the link between military and commercial aerospace. As administrators of the Aircraft and Ordnance Division, they oversee the military production that dominates the industry. In the late 1970s, MITI endorsed stepped-up military production as a more timely, controllable, and realistic means to develop an aerospace industry, as well as a good way to help the electronics industry move from consumer to capital goods. Defense manufacturing also promised to absorb the human and capital resources displaced from the troubled heavy industrial sector. MITI officials have worked closely with the JDA and private firms to ensure that the defense budget is advancing industrial goals as well as military ones. The demise of the 7J7 and the problems at IAE have only increased the relative importance of military efforts in MITI's policy portfolio.

This shift in priorities has shaped Japanese policy toward the FSX. Officials at MITI and other government agencies favor the FSX project because they recognize that the technology, manufacturing processes, and industrial organization needed to produce a first-class jet fighter present valuable new opportunities for Japanese aerospace.

The Next Generation

Modern jet fighters are remarkably complex, high-performance machines. The largest weigh up to 20 tons empty, and the most powerful carry more than their own weight in fuel and armaments. These fighters travel at altitudes ranging from 100 feet to 10 miles and at speeds exceeding 1,500 miles per hour, and they execute maneuvers that will cause the pilot to lose consciousness before the limits of the airframe are reached. Their avionics meld a bewildering array of electronic, electro-mechanical and opto-electronic equipment that must function despite extreme temperature, shock, vibration, g-force, and—in the event of nuclear war—even electromagnetic pulse. Although many nations now produce low-performance tactical aircraft, those

Japan's F-15J was designed entirely in the United States, then co-produced with the Japanese. This kind of arrangement, Japanese policymakers say, transfers "know-how" but not "know-why."

with the technological, managerial, and financial wherewithal to design and deploy top-of-the-line fighters form an exclusive club, and they pay dearly for membership. Until the shift in exchange rates in the mid-1980s, U.S. spending for fighter R&D typically exceeded the annual revenues of the entire Japanese aerospace industry.

The industrial requirements of the fighter business have altered radically in the last decade. The old school of design stressed size and speed and depended largely on advanced techniques for metal-bending. This approach reached its peak in the early 1970s with the F-15, a very large and very fast all-metal airplane with mechanical controls and instruments. The F-16 and F-18, dating from the mid-1970s, are transitional aircraft that blend old and new technologies. The next generation, still in the R&D stage, relies heavily on a broad range of new technologies. For example, composite structural materials make for lighter weight, less visibility, and more streamlined contours. "Fly-by-wire" systems, in which mechanical controls are replaced by computerized actuators, allow software algorithms to fly the plane. Miniaturized, sophisticated sensors, displays, and avionics are tied directly into the flight-control system. Finally, researchers have joined these new technologies into control-configured vehicles, or CCVs. Extremely agile CCVs, with odd-looking airframes, unstable aerodynamics, and constant computer control, have flight capabilities more akin to a flying saucer than a traditional fighter plane.

Like all final products in aerospace, fighters require long lead times and high R&D expenditures. Each is an intricate assembly of subsystems—structure, propulsion, avionics, and armaments—and each subsystem consists of numerous components, including many that push the limits of whatever technologies are involved. The formidable manufacturing process requires large investments of capital and labor as well as elaborate facilities, highly skilled workers, and slow learning curves.

In addition to these financial and technical demands, the production of these sophisticated machines poses new managerial challenges. Their design and manufacture depends on systems integration, which involves not only the way the components must be made to fit and work together but the strategy for managing operations as a whole. Integration problems are magnified when development and production take place concurrently, many organizations are involved, and even the smallest sub-systems can create major delays and difficulties. Systems integration is the most challenging aspect of aerospace production, and because full-scale programs are infrequent, opportunities to acquire these skills are rare.

New technologies have also brought structural change to the industry. For the first time, U.S. prime contractors have been forced to team up to spread costs and risks that the Department of Defense, facing new budgetary pressures, is no longer willing to absorb. At least one and perhaps two or three U.S. producers will probably drop out of the tactical aircraft business, and others may disappear through merger and divestiture. Those that remain will participate either in team production of new aircraft or in less costly programs to retrofit existing aircraft with new technologies.

How might these changes affect Japanese ambitions? It is tempting to argue that they can only increase the

PHOTO: JAPANESE DEFENSE AGENCY

Government-subsidized R&D projects have helped the Japanese aerospace industry develop expertise in next-generation technologies. The T-2 CCV (right) is an experimental "control-configured vehicle" that incorporates a computerized "fly-by-wire" control system and other advanced technologies. As the diagrams suggest, it is far more maneuverable than a traditional fighter plane.

competitive advantage of experienced American firms. However, they are more likely to have the opposite effect, for the specific demands of the next generation of aircraft make virtues of the technological, organizational, and managerial characteristics of Japanese industry. Japan is on the leading edge of technology in advanced materials, microelectronics, and other relevant areas, an advantage that the spin-on strategy deliberately exploits. Organizationally, the close relationships that Japanese aerospace maintains with other industries will speed the assimilation of new technologies. Managerially, Japanese companies have 30 years of experience with interfirm cooperation, while it is a brave new world for their American counterparts.

Japan's Structural Advantage

The structure of the Japanese aerospace industry offers producers a key advantage over Western competitors. In the United States, the traditional structure has been a distinct pyramid, with a dozen or so large prime contracting firms specializing in aerospace at the top. In a typical program, the winning prime contractor will do system R&D, manufacture most of the main structures, and perform final assembly, integration, and testing. Contracts for the major subsystems are shared among other primes and a larger number of subsystem manufacturers, which let out work to thousands of small component fabricators and machine shops. The general structure of European aerospace is similar. Both industries (and their government customers) rely heavily on exports to lower unit costs.

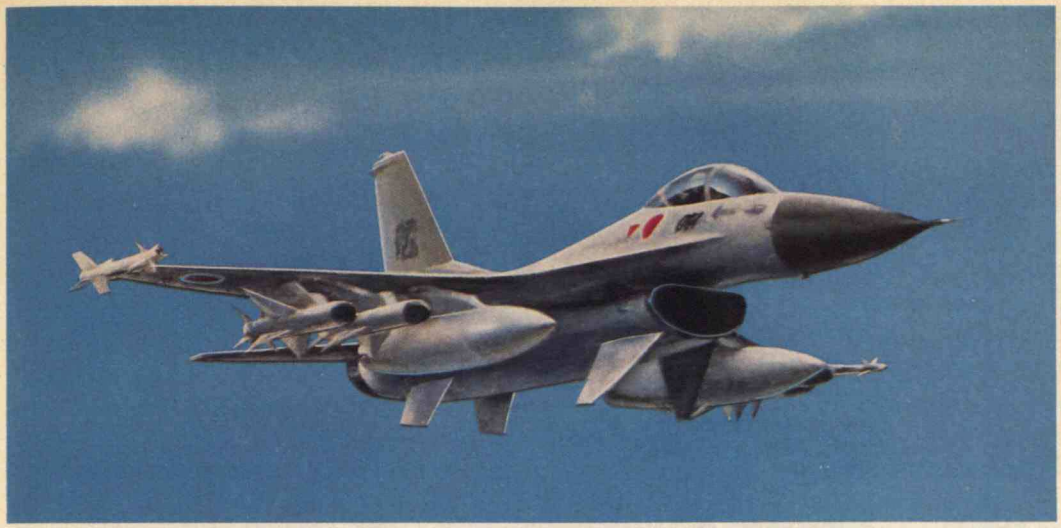
By contrast, the Japanese aerospace industry is organized as divisions of diversified heavy industrial companies, which are affiliated with important *keiretsu,* the finance-centered business groups descended from the prewar *zaibatsu* trusts. As a result, aerospace is more closely linked to other industrial sectors, both within the firms and within the *keiretsu*. These links promote the identification and transfer of technologies that can be used for more than one purpose.

The industry is far more concentrated than in the United States, with four firms controlling almost all the prime contract market. Mitsubishi Heavy Industries (MHI) has almost half, and Kawasaki Heavy Industries (KHI) and Ishikawajima-Harima Heavy Industries (IHI) account for about one-fifth each. Fuji Heavy Industries (FHI) makes up much of the rest.

Japanese aerospace is far more openly collusive as well. The Japanese describe it as a sort of "friendship club" (*nakayoshi kurabu*). Government policy encourages cartelization: legislation such as the First Aircraft Industry Promotion Law of 1954 encourages cooperation among firms, and every major aerospace program has been divided up so that the "big four" companies participate. By American standards, the stability of these partnerships and the extent of collaboration are extraordinary. Carefully orchestrated work-sharing, coordinated investment strategies, and managed competition among the leading firms—all backed by extensive state support—are prominent features of the industry.

Yet the lack of experience in systems-level R&D and design, systems integration, and international sales and support remains problematic. The mainstay of Japanese aerospace has been licensed co-production of U.S. warplanes, for which R&D has long been completed, all systems-integration problems have already

PHOTO & DIAGRAMS: SOCIETY OF JAPANESE AEROSPACE COMPANIES



The joint U.S.-Japanese agreement to develop the FSX (left) acknowledges Japan's new status as a technological power. Japanese firms are responsible for 60 percent of the new aircraft.

been solved, and export sales are out of the question. Co-production, even with steadily increasing local content, is equivalent to following a script; Japanese officials often deplore it as a transfer of "know-how" but not "know-why." One senior industry leader used the metaphor of a hand-me-down garment to describe how Japanese firms approach licensed co-production: "First you put it on, then you grow out of it." Still, during the 1980s, Japan has made considerable progress in remedying its deficiencies in aerospace. Technological competence, managerial experience, and facilities for research, development, and production have all improved substantially. The FSX program will allow planners to capitalize on and continue this process.

The Debate Over the FSX

The military impetus for the FSX project came from Japan's decision to strengthen its air power and become, in the controversial words of former Prime Minister Nakasone, "an unsinkable aircraft carrier." Japan needs expanded airpower to protect its territory, airspace, coastal waters, and sea lanes out to 1,000 miles—a commitment made as part of the "roles and missions" philosophy that guides defense cooperation between the United States and Japan. Today, the Japan Air Self-Defense Force (JASDF) flies three different fighters: the F-4J and F-15J, designed in the United States in the 1950s and 1960s, respectively, and co-produced in Japan; and the F-1, the first postwar Japanese-made fighter, a smaller, slower, and less capable craft that first flew in 1977. By the early 1980s, JASDF officials were already concerned about technical obsolescence and metal fatigue in the F-1 fighters. They identified a need to replace some of the F-4Js as well. When the JDA decided to phase out the F-1 earlier than anticipated, the formal requirement for the FSX (Fighter Support, Experimental) was born.

The need for the new aircraft was uncontroversial, but the question of how it would be designed and produced immediately gave rise to debate. At the outset, private industry, the JDA's Technical Research and Development Institute (TRDI) and Air Staff Office, and MITI's Aircraft and Ordnance Division argued that the time had come for Japan to design its own advanced aircraft. Their position was strengthened by clear indications that the United States was adopting a tougher stance on technology transfer. They feared that Japan's aerospace industry would fall hopelessly behind if the government settled for restricted co-production of an existing aircraft.

However, there were then few reasons to believe that Japan had the technological or budgetary resources to design and build a competitive fighter. The high cost of such a project generated opposition: the plane would be needed only in limited quantities at home and could not be produced for export. Budget officials in JDA, MITI, and especially the Ministry of Finance viewed domestic development as a good way to pay more and buy less.

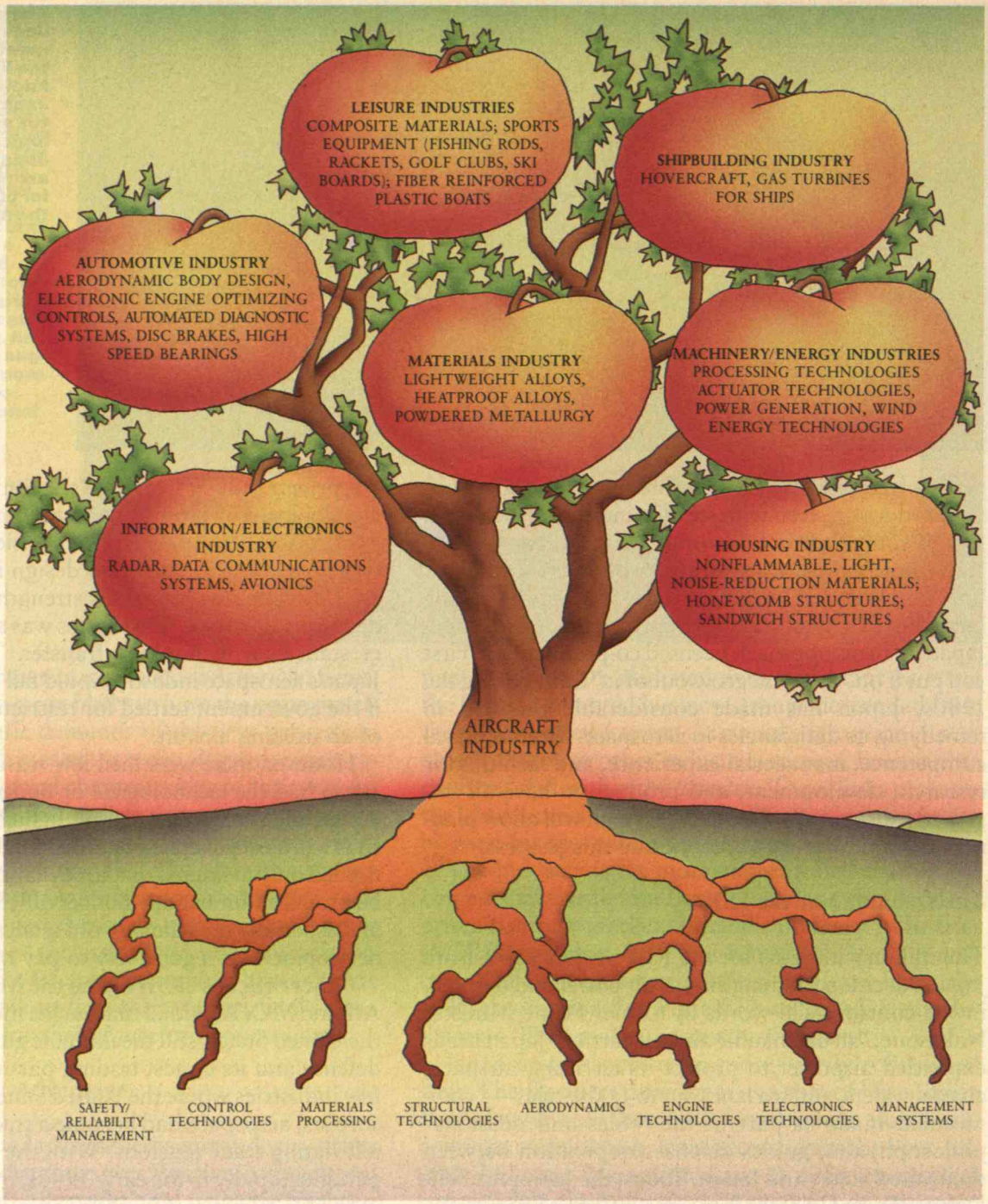
Other officials at MITI and the Ministry of Foreign Affairs (MOFA) added that such a move could alienate the United States, still the ultimate guarantor of Japan's defense and its largest trading partner. As one of the few industries where the United States ran a consistent surplus, aerospace had become a traditional means of alleviating trade tensions. With the trade surplus expanding rapidly in the early 1980s, officials concerned with U.S. relations viewed the proposal for a domestic fighter as a step in the wrong direction.

Given the lack of consensus, it seemed likely that a foreign design or even a foreign purchase would be selected for the plane if a decision to go ahead was made on schedule in 1984. Therefore, officials pushing for an indigenous aircraft bought time for domestic producers to get their own FSX program up and running. The JDA initiated a Service Life Extension Program (SLEP) to reinforce the F-1s and refit them with new technology, extending their lives for several more years. In early 1986, MHI was awarded a $400 million contract to update 100 F-4Js as well.

While the SLEP mollified the U.S. and MOFA because it involved the purchase of American technolo-

PHOTO: MITSUBISHI HEAVY INDUSTRIES

Japanese policymakers talk about the "roots" and "fruits" of aerospace that will sustain the country's economy into the twenty-first century. The industry will develop process technologies and product innovations that will find uses in many other sectors.



gy, it allowed government and industry to continue to strengthen Japanese abilities in aerospace. TRDI had begun funding next-generation fighter studies in the 1970s, primarily to identify needed technologies. On the basis of the findings, the agency embarked upon an ambitious program to correct domestic deficiencies and foster indigenous expertise in fields such as advanced metallurgy, composite materials, stealth technology, avionics, and CCV.

But this work was no substitute for experience in managing the full scale design and production of a new aircraft. The JDA decided to design and produce the supersonic XT-4 jet trainer, a smaller, simpler, and much less expensive craft than a fighter, but one that nevertheless replicated in miniature the challenges of the FSX. The XT-4 relied almost exclusively on Japanese technology and companies. Despite their inexperience, Japanese managers, again from the four major firms operating in close collaboration, showed their mettle: the first plane rolled out a month early and on budget, an exceedingly rare event in aerospace. Equally unusual, the XT-4 reportedly met all specifications during flight testing and entered initial production on schedule in 1986. The success of the project contributed greatly to the increasing self-confidence and domestic credibility of the Japanese aerospace industry.

DIAGRAM: INTERNATIONAL AERO ENGINES

The FSX will give a generation of Japanese aerospace engineers design experience with high-performance aircraft.

From Co-Production to Co-Development

By the time the FSX decision reappeared on the agenda in the spring of 1986, three developments in Japan had tipped the balance toward domestic development. First, the coalition fighting for an indigenous FSX could present the plane as a replacement for two different aircraft types instead of the original one, making it more economically feasible. Second, deployment had been rescheduled from 1986 to 1997, which meant the coalition could argue persuasively that an American aircraft designed in the early 1970s would be obsolete by the time it was finished. Third, a consensus had emerged within industry and government that the military application of civilian high technology presented a major opportunity that should be recognized and nurtured. Expertise with composite materials developed in the sporting goods industry, with semiconductors developed in consumer electronics, and other technologies with equally peaceful origins, were available for a Japanese jet fighter.

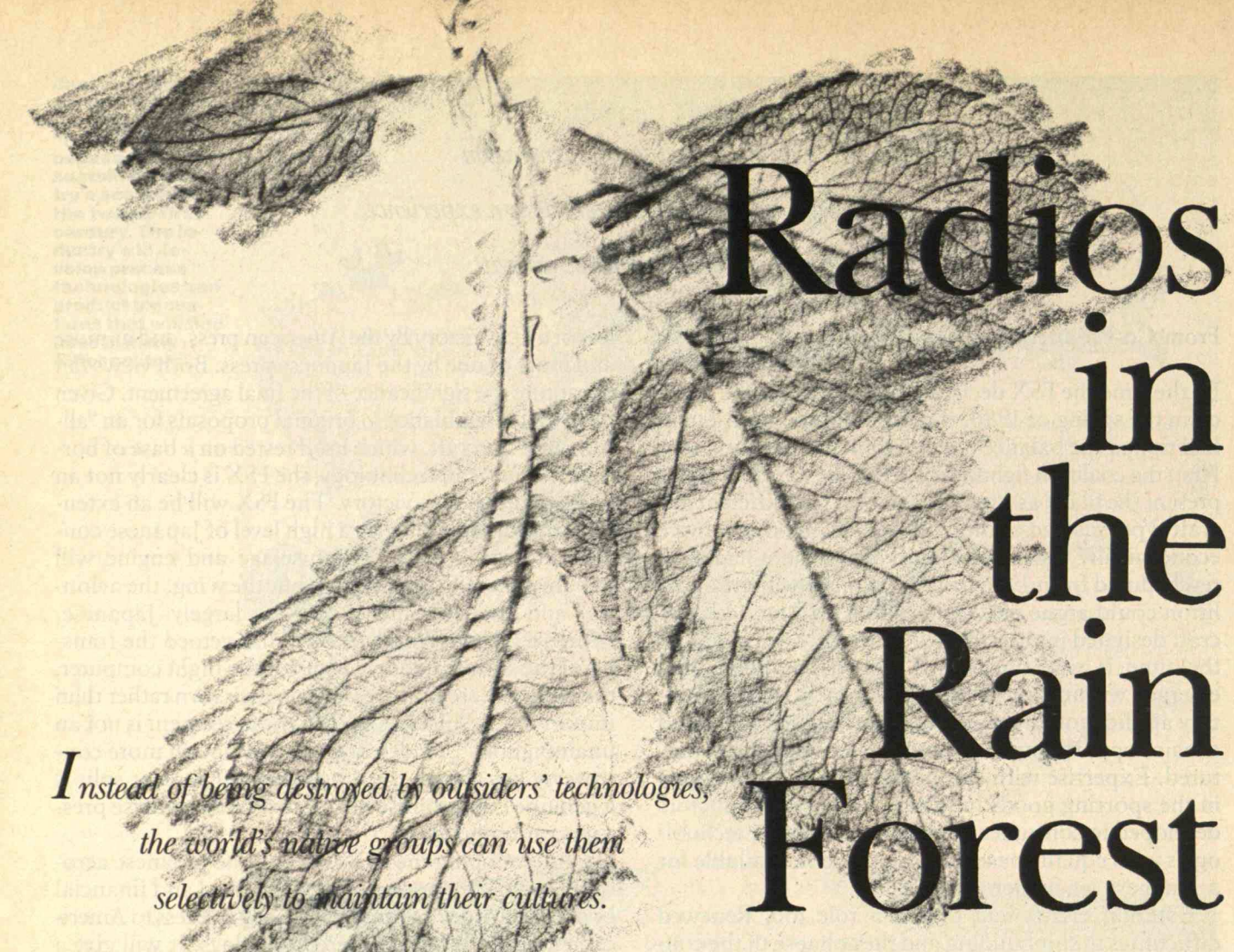
External events had played a role too. Renewed difficulties in shipbuilding and the collapse of the construction business in the Middle East had intensified heavy industry's need to diversify and the government's desire to help it do so. And growing frustration with the 7J7 and IAE had undermined the perceived wisdom of being a junior partner in international consortia. As a result of all these factors, domestic opposition to domestic development had largely withered. U.S. pressure remained a significant obstacle, but this pressure also rallied support for domestic production as an assertion of national sovereignty.

It came as a surprise to most observers, then, when Director-General Kurihara Yuko of the JDA announced in October 1987 that Japan intended to forgo domestic development of the FSX and instead would spend $6 billion to procure a "lightly modified" American aircraft. The statement was widely interpreted as a conciliatory gesture on the part of the departing Nakasone administration and an unambiguous victory for the United States. American officials praised the prime minister and Kurihara for realizing that—given U.S. strength in aerospace, the $60 billion bilateral trade deficit, and concern about "interoperability" and "burden sharing" between American and Japanese military forces—a "buy American" policy was appropriate.

But as the general framework of the FSX agreement was worked out, the project was portrayed as less and less of a U.S. victory by the American press, and as more and more of one by the Japanese press. Both views fail to capture the significance of the final agreement. Given its strong resemblance to original proposals for an "all-Japanese" aircraft, which itself rested on a base of borrowed American technology, the FSX is clearly not an unambiguous U.S. victory. The FSX will be an extensively modified F-16 with a high level of Japanese content and technology. The fuselage and engine will remain generally unchanged, but the wing, the avionics, and the armaments will be largely Japanese. Moreover, since President Bush has vetoed the transfer of the software source code for the flight computer, the Japanese are likely to develop their own rather than import a U.S. "black box." But the agreement is not an unambiguous U.S. defeat either. Although more controversy lies ahead, the 60 percent-40 percent split is a genuine compromise negotiated under intense pressures on both sides.

Co-developing the FSX will give the Japanese aerospace industry a powerful technological and financial boost. It provides a formal structure for access to American expertise in areas where Japan lags. It will give a generation of Japanese aerospace engineers design experience with high-performance aircraft. And it will provide a massive capital inflow to underwrite continued expansion of Japan's aerospace industrial plant, where military and commercial production take place in tandem. Such a plan is very different from the co-production model that it replaces, and it will unquestionably advance Japan's long-range goal of competing effectively in world aerospace markets.

As much as a decade ago, some Japanese planners argued that the country's aerospace industry was competitive technologically but not economically, because of the small domestic market and the restrictions on military-related exports. The co-development of the FSX represents a critical step in a strategy of using military procurement to overcome these barriers. In the words of Morikawa Hiroshi, executive director of the influential Keidanren Defense Production Committee, "We have no alternative but to pin our hopes on the FSX, given the current lack of progress in plans to jointly develop commercial aircraft." Planners and industrialists believe that a vibrant military aerospace program, spinning on an axis of dual-use technology, can make the Japanese aircraft industry a global player in aerospace by the early part of the next century. ■



Radios in the Rain Forest

Instead of being destroyed by outsiders' technologies, the world's native groups can use them selectively to maintain their cultures.

BY JASON W. CLAY

WITHIN living memory, the Shuar Indians of Ecuador's eastern Amazonian rain forest fought bitterly among themselves. After World War II, the 40,000 or so Shuar came in contact with colonists. As a result of increasing conflicts over land with the outsiders, Shuar villages put aside their differences and formed one of the strongest indigenous federations in Latin America.

As the Shuar became integrated into the national society, they realized that their children needed education in order to avoid discrimination and exploitation. At first, however, children had to leave their homes and traditional life for boarding schools that were controlled by another culture. The choice was either to be educated or be Shuar.

Since 1980, technology—in the form of a radio education program—has been helping the Shuar maintain their culture while getting an education. Assisted with $40,000 from Cultural Survival, the human rights organization I work for, and the Inter-American Foundation, which funds development projects, Shuar teachers broadcast science and history lessons from a Shuar perspective. The villages have portable receivers and trained assistants who help the children in three-hour morning classes. Not only do the pupils retain their Shuar identity, but they score higher than the national average on exams. The radios are also used for educating adults and keeping the communities informed about events outside their area.

The Shuar are a living testimony to the fact that tribal groups do not belong in the dustbin of history. The all-too-common assumption is that indigenous groups' destruction is inevitable with the advance of modern civilization. It is true that for centuries contact with outside groups has destroyed native populations throughout the world. The technologies that the newcomers brought—weapons, vehicles, and other equipment—has most often been used to displace people and deny their rights to resources.

Such interference has gained speed in recent years. The outlook for indigenous peoples, who number 500 million worldwide and live in 15,000 groups, is deteriorating. Five million tribal people have been killed as the result of warfare waged by their own governments since World War II, and 110 million have been displaced. This century has witnessed more extinctions of native peoples than any other.

But today, a number of groups such as the Shuar have started using imported technologies to protect their ways of life and assert their rights over their lands. The groups that have survived contact with

A member of the Shavante tribe of Brazil carries both a briefcase and a traditional war club on his way to discussing the group's land claims with government officials.

PHOTO: ORLANDO BRITO-BRASILIO

In India, the Irulu have discovered that their hunting skills can help them turn a profit in the twentieth-century marketplace. They catch snakes, milk their venom, and sell it to labs that make snakebite antidotes.

outsiders and successfully adapted to others' economic and political systems have maintained their identity by selectively combining traditional with modern technologies.

To survive, native groups must make decisions about their future. Outsiders can help them by providing information about the range of choices—and their implications. The twentieth century can be remembered either as the century when technology was used for genocide or to help the world's peoples learn to live together.

Asbestos and Toxic Waste Dumps

Technology can pose a variety of problems to tribal groups. For instance, helicopters, satellites, and telecommunications equipment have aided countries and corporations in resource development projects such as oil drilling that can lead to the elimination of native populations. Surveys have been made of the lands inhabited by even the most isolated societies, such as the Mbuti pygmies of Zaire, the Penan of Sarawak, and the Yanomamo of Brazil.

Moreover, many industrial processes that have become highly regulated in certain countries now endanger the lands of indigenous groups elsewhere. Through the 1960s, tribal groups working as laborers in asbestos plants in South Africa did not know about the health dangers of asbestos as they jumped up and down on bags of it to pack them tight. And sometimes, with the collaboration of elites in the Third World, industrialized countries dump their hazardous wastes on unsuspecting tribal peoples. In 1988 in West Africa, the president of Benin decided to place a dump for European toxic waste in the middle of the area where his tribal opposition lives. Only international criticism stopped the project.

Technological threats to indigenous peoples can also be similar to those still faced by developed countries. The Chernobyl explosion abruptly ended the traditional way of life for the Sami of northern Scandinavia. All the foods they ate or sold, including reindeer, fish, herbs, berries, and mushrooms, were contaminated. Apparently because the governments overseeing the Sami's lands—Norway, Sweden, and Finland—themselves depend on nuclear energy, they have prohibited the group from suing the Soviet Union for compensation. The future of tens of thousands of Sami, who as a result increasingly depend on welfare, is in question.

Robbed of their means of livelihood, groups like the Sami are forced to adapt to larger societies whose language and customs they do not know. In several countries it is against the law to speak one's own language. That's the case for the 10 million Kurds in Turkey. And lacking the educational and technical skills needed to succeed in the broader societies, indigenous groups generally suffer from poverty, lack of political power, and cultural alienation.

Putting Outside Technologies to Good Use

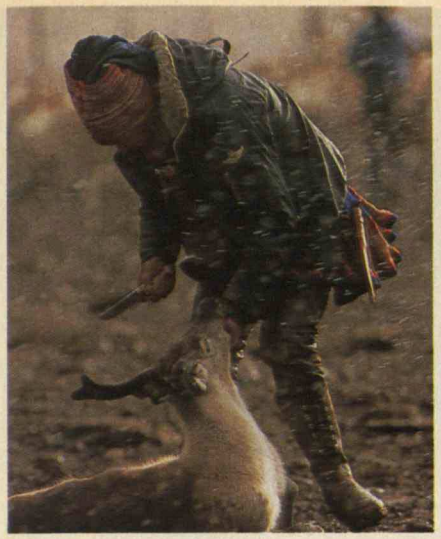
Technology need not always be a disruptive force. Tribal groups can employ a wide range of technologies to defend their ways of life and insure their future. Some groups are using technologies to help maintain their land. Others have selectively adopted technologies to fight diseases brought by outsiders or to educate their own people about the world around them. The following cases show how indigenous groups are using technologies and working with the outside world to maintain their cultures today.

The Huichol of Mexico, wanting to protect their forests, asked Cultural Survival and other agencies in 1980 to help them improve their forest management. In previous decades, the group had supplemented its subsistence agriculture by selling timber concessions to companies that not only cut the best trees but often removed timber to which they were not entitled.

The Huichol asked an anthropologist working with them how they could make the same amount

JASON W. CLAY, an anthropologist, is director of research and publications editor at Cultural Survival, an organization concerned with indigenous populations. He received a doctorate from Cornell University after studying at the London School of Economics and Political Science and at Harvard College. Clay is now working with Amazonian tribal groups and other forest dwellers who want to sell rain forest products, including tropical nuts to be used in a commercial ice cream and plants to be used in a line of cosmetics. The products will increase the people's income and promote forest preservation.

PHOTO: ROM WHITAKER



Technological threats can devastate native cultures. In Scandinavia, for example, contamination from Chernobyl has forced the Sami to slaughter the reindeer they have traditionally herded (far left).

On the other hand, groups like the Huichol of Mexico are using technology to insure their future (near left). They have taken charge of logging on their lands, and—since they've also mastered basic carpentry—they can earn more than 300 times as much income from each log.

of money yet reduce the destruction of their forests. He contacted a forestry expert at a local university who taught the Huichol how many and what trees they should take from their lands.

The tribe ended the timber concessions and took over the logging themselves. And with help from one assistance agency, they learned how to dry the wood quickly using a solar-powered kiln. (Since the kiln could break down and leave the Huichol with a new problem, the agency agreed to make any repairs in the future.) For its part, Cultural Survival paid an Indian from another tribe to teach the Huichol basic carpentry skills.

By making and marketing wooden boxes, tables, desks, and chairs, the Huichol now receive more than 300 times as much income from each log cut on their land as when they sold timber concessions. They have also reduced deforestation. Indeed, they have even encouraged reforestation by selectively cutting damaged and diseased trees.

The Irulu of India, a group of nearly 100,000 hunters and gatherers, were forced to change their way of life after immigrant farmers took over and destroyed many of their forests. The leaders of a small sector of the Irulu, who live in three southern states, knew that they had to find a way to make a living as a group or their culture would disappear. At first the members of this group—about 300 families who total 2,000 to 3,000 people—caught snakes and sold their skins. But in 1978, an Indian scientist interested in protecting the snakes helped the families figure out a better way to make a living. The scientist put the group in touch with laboratories that make an antidote serum for poisonous snakes. Shortly before India made snakeskin trading illegal, the families formed a cooperative for catching snakes, milking their venom, and selling it to the labs. Unlike collectors who kill the animals, the Irulu release the snakes back into the wild for future stock.

Recently the same group of Irulu have come up with another idea: hiring themselves out to peasant farmers to rid villages of mice and rats, which eat a significant portion of the harvest. The Irulu's technology is not dangerous rat poison, but nonpoisonous snakes that they release into mouse and rat holes to catch and eat the pests. The Irulu are using their hunting skills to make a decent living, and their tribal pride is resurging.

The Kuna of Panama, who live in the country's only remaining rain forest, established a "biosphere reserve" in the last several years to protect their lands. Established with the assistance of Cultural Survival, the Inter-American Foundation, the Smithsonian Tropical Research Institute, the World Wildlife Fund, and the U.S. Agency for International Development, the reserve provides the Kuna with revenue from tourist entrance fees and the sale of research rights to scientists.

The Kuna are learning to employ a "technology" of an intellectual sort to protect their heritage. They require reports from researchers leaving the area, so they can check whether the outsiders are interested in genetically manipulating any plants that the Kuna have helped breed or select for. If scientists plan to work with species in the hope of claiming patent rights, the Kuna can notify the organizations that helped them set up the reserve so the tribe can lay partial claim to the rights as well.

The Kuna also require each scientist to take a paid native assistant along. In this way they not only make sure that scientists don't get hurt or lost, but can observe conditions throughout the park.

The Shavante of Brazil are learning how to mix modern and traditional technologies to protect their land. They have concluded that sustained contacts with outsiders since the 1950s have gradually eroded their original way of life. In the past decade, FUNAI, the government Indian agency, encouraged the Shavante to adopt capital-intensive agriculture by giving them tractors to farm rice, beans, and manioc. The

PHOTOS: J. DONOSO, SYGMA; TED MACDONALD

Contact with the West need not destroy the character of a tribe. The Shavante traditionally performed their ceremonial dances wearing red paint, as the 1958 photo at top shows. In the recent photo at bottom, they're performing the same dances—except that they're wearing red soccer shorts along with the paint.

agency wanted to show how technology could help assimilate tribal groups into the Brazilian society.

Although the Shavante were interested in becoming "modern," they began to note that production declined when they farmed the same fields year after year—even using fertilizers and insecticides. What's more, prices for fertilizers and gasoline—all imported—rose rapidly as the U.S. dollar increased relative to the Brazilian cruzado. At the same time, the prices the Shavante could get for their produce declined as farming colonists moved into the area and food production increased.

In 1988, after their equipment started breaking down and the government was slow to replace it, the Shavante met with agronomists from a local university. They learned how to produce and sell traditional commodities, such as a fruit called the custard apple and a chunky flour from native palms that is eaten as a snack. They also established a trading company to export their produce to countries where the crops fetch a higher price than in Brazil. Several British and West German companies are now considering marketing goods made from traditional Shavante products.

Lost Tribes: The World's Loss

Within the next few decades, the fate of the world's remaining tribal groups could be decided once and for all. Governments and corporations can include indigenous groups in development decisions—and help them learn about technologies they may want to use to maintain their existence. Or the powerful outside groups can continue using various technologies to destroy these cultures.

The dismantling of tribal cultures is not only unspeakably barbaric, but costly to dominant cultures as well. Resource and industrial development often results in political instability or wars. More than 80 percent of the world's armed conflicts involve indig-

PHOTOS: DAVID MAYBURY-LEWIS, BILL CRAWFORD

Representatives of Brazilian tribes attend a hearing on the country's new constitution, which guarantees more rights to indigenous peoples. Dominant cultures benefit by accommodating such groups, since 80 percent of the world's armed conflicts stem from disputes over tribal claims.

enous groups trying to defend themselves against governments that supposedly represent them. In Sudan, for example, the government—dominated by northern Sudanese Muslim groups—and its tribal allies have displaced more than two-thirds of the 6 million Christian and animist members of tribal groups living in the southern third of the country.

Half the Third World debt results from militarization, usually for internal security—that is, fighting tribal citizens. Such debt often results in a vicious circle. It can lead governments to raise taxes, to lower the prices they pay their own citizens for export crops, or to displace tribal peoples in order to exploit natural resources or to establish commercial farms for cash crops. Any of these tactics can cause further conflict, since at some point many larger groups would rather fight than abandon their homelands, earn less money for their goods, or pay more taxes for services they don't receive.

As suggested by the Sudanese example, warfare also makes refugees of formerly self-sufficient tribal populations. They then become dependent not only on the countries that create or receive them, but on the relief provided by the rest of the world as well.

And in many countries, particularly in Africa, conflict between governments and tribes is the main cause of the disruption of food production that results in famine. In Ethiopia, warfare and government policies aimed at relocating farmers to villages where the state could define and appropriate agricultural "surpluses" caused most of the million deaths related to the 1984-85 famine. By 1992, even if the growing season is good, the relocations will probably create a food shortage even worse than that during the last famine, according to Cultural Survival's research and U.S. government studies.

This cycle of creating poverty is severely testing international humanitarian impulses. The world spent $2 billion on the Ethiopian famine. Such expenses divert resources from development activities that might improve the prospects of indigenous peoples in more long-term ways.

Historically, great advances in civilization have come not from the elimination of groups but from interaction between cultures. For example, base-10 arithmetic spread from the Middle East to the Western world. And the organization of the League of the Iroquois had a profound effect on the forming of the U.S. Constitution, which is arguably one of the most influential documents ever written. Native groups have intimate knowledge of local flora and fauna—information that in the past has helped outsiders discover useful foods, as well as medicines such as curare and ipecac. Indigenous peoples have also gained a deep understanding of soils and climatic variables that affect production. This knowledge could clearly help immigrant farmers and government planners.

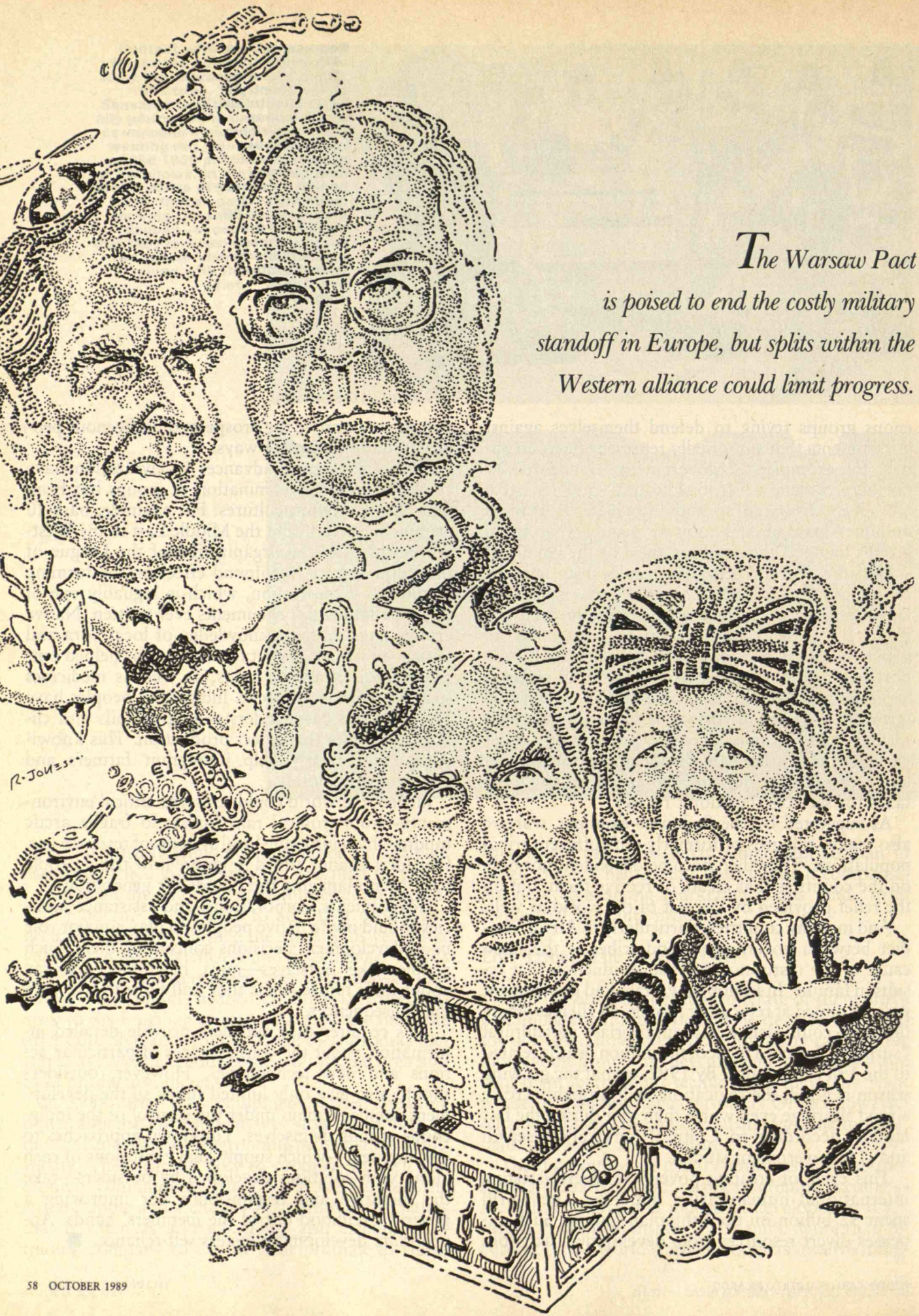
Indeed, the world could conserve critical environments—from tropical rain forests to fragile arctic tundra—by reinforcing local systems of resource use. Outsiders cannot afford to ignore how tribal people have been managing their lands for generations.

Governments, corporations, and assistance agencies should invite native peoples to play a major role in all development decisions concerning them. Such people—like ourselves—must have the final say about their future, since they will have to live with the consequences.

This requires that outsiders provide detailed information about the consequences of particular actions and new technologies. However, outsiders should also give only limited funds so the development choices remain under the control of the indigenous groups themselves. Top-down approaches to development—which supply heavy infusions of cash along with solutions developed by outsiders—take the initiative and responsibility for improving a group's livelihood out of the members' hands. Appropriate development fosters self-reliance. ■

PHOTO: CARLOS ALBERTO RICARDO

The Warsaw Pact is poised to end the costly military standoff in Europe, but splits within the Western alliance could limit progress.

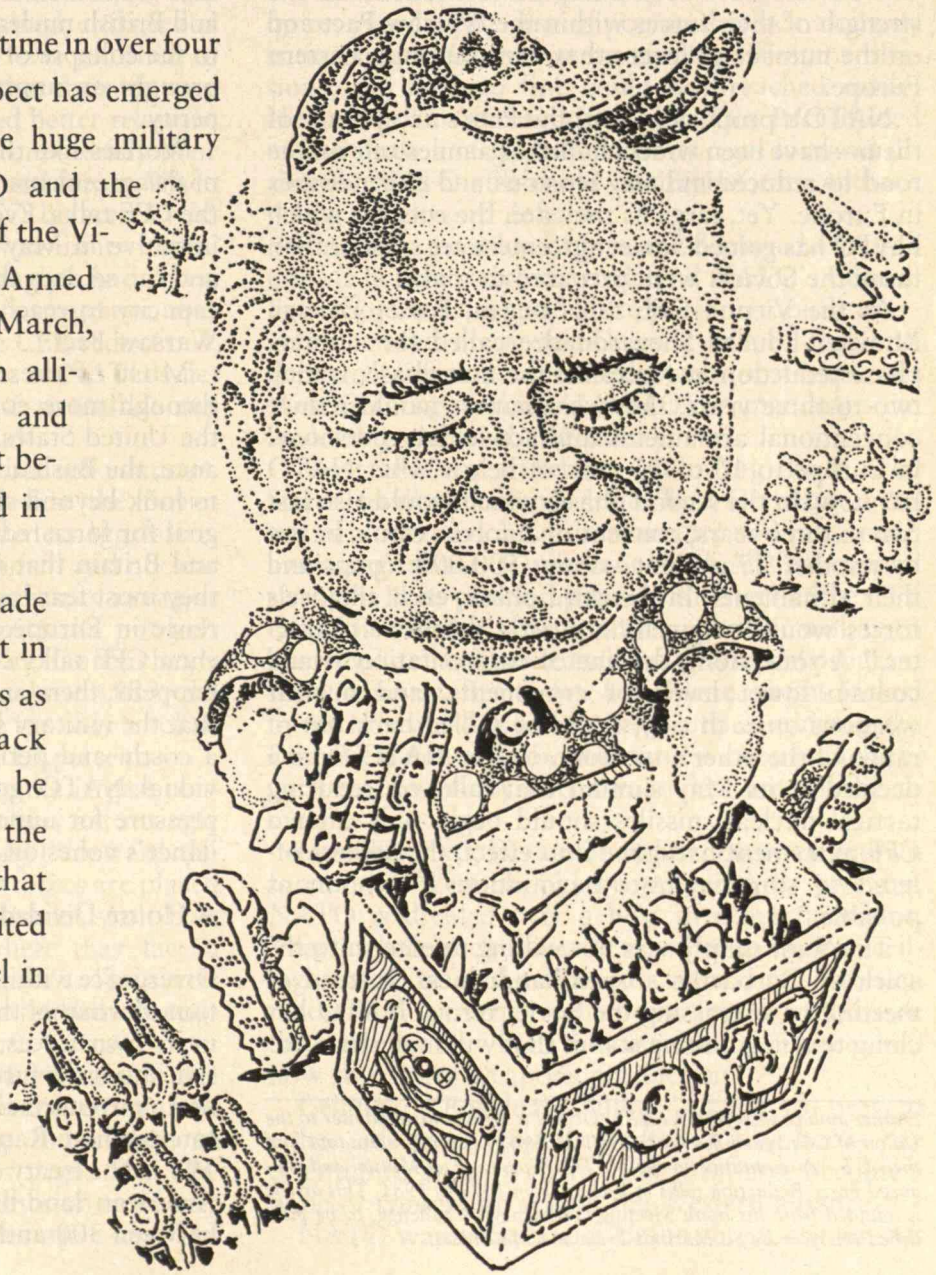


Can NATO Agree on Arms Control?

THIS year, for the first time in over four decades, a real prospect has emerged for cutting back the huge military confrontation between NATO and the Warsaw Pact. At the opening of the Vienna talks on Conventional Armed Forces in Europe (CFE) in March, NATO proposed cuts in both alliances' armored troop carriers and main battle tanks to 10 percent below NATO's current level, and in artillery to 5 percent below.

In May, President Bush made headlines at the NATO summit in Brussels by calling for other cuts as well. He suggested that attack planes and combat helicopters be reduced to 15 percent below the NATO level. And he proposed that the Soviet Union and the United States reduce military personnel in

BY JONATHAN DEAN



ILLUSTRATIONS: ROGER JONES

Central Europe to 275,000, a cut that he presented as 20 percent of U.S. combat personnel but that is not quite 10 percent of the total American strength of 305,000 in Europe.

The Soviet Union has agreed in principle to deep cuts in tanks, artillery, and troop carriers—cuts that are vastly asymmetrical in NATO's favor. For example, the Warsaw Pact will have to eliminate 37,000 tanks, 65 percent of its entire tank force west of the Urals. NATO will withdraw only about 2,000. The Soviets have even accepted restrictions on the strength of their forces within the Warsaw Pact and on the number of forces they can station in Eastern Europe.

NATO's proposals—and the Pact's acceptance of them—have been widely hailed as a milestone on the road to reduced military tensions and expenditures in Europe. Yet, large as they are, the cuts for which NATO has gained Soviet agreement are smaller than those the Soviets were prepared to make.

As the Vienna CFE talks began, Soviet Foreign Minister Eduard Shevardnadze called for a three-phase reduction in forces. In the first phase, lasting two to three years, the two alliances would reduce conventional armaments and active-duty personnel in Europe to 10 to 15 percent below what NATO has now. In the second phase, which would also last two to three years, conventional forces would be cut by another 25 percent—about 500,000 troops and their armaments. In the third phase, each alliance's forces would be given "a strictly defensive character." A zone along the line of confrontation would contain lower levels of armaments, and nuclear weapons on each side would be pulled back out of range of the other's territory. Unlike NATO, which decided at its May summit that talks on reducing tactical nuclear missiles should begin only after a CFE agreement had gone into effect, the Soviets offered to start separate negotiations "as soon as possible."

The West simply was not willing to enter into the spirit of Gorbachev's open-handedness. Instead of meeting or surpassing the Soviet terms, NATO has clung to a negotiating stance that will make the confrontation more equal but do little to decrease its scale or its cost to the West.

Many NATO states, especially France and the United Kingdom, remain unconvinced that deep force reductions will enhance their security. They fear that they are being drawn into a negotiating process that could lead to the wholesale withdrawal of U.S. forces from Europe, including the nuclear weapons they view as a hedge against a Soviet return to expansionism. They also foresee irresistible pressure from their own publics for eliminating French and British nuclear arms. This, they fear, could lead to the collapse of the entire postwar system that has brought an unprecedented era of peace and prosperity.

Worries like these have prompted a broad range of disagreements within NATO on the substance of the CFE talks. Even after President Bush's successful initiative in May 1989, the splits are so numerous and run so deep that they cast real doubt on NATO's capacity to reach an early first agreement with the Warsaw Pact.

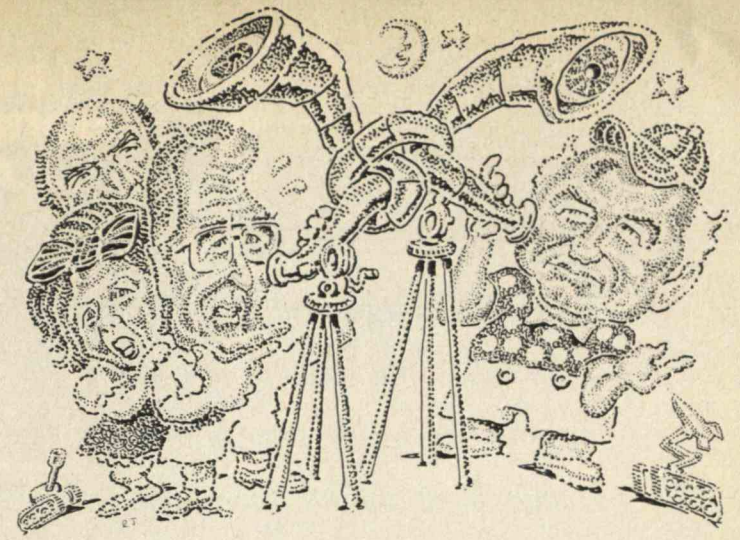
Most of these problems could be overcome through more consistent leadership on the part of the United States. To achieve unity within the alliance, the Bush administration needs to get its allies to look beyond short-term cuts and set a long-term goal for force reductions. It must also assure France and Britain that it intends to help them keep what they most fear losing: some degree of nuclear deterrence in Europe. Without such leadership, the Vienna CFE talks could easily bog down. And if that happens, there are only two likely outcomes. One is that the military standoff in Europe will continue at a costly and perilous level. The other is that individual NATO governments will bow to domestic pressure for unilateral cuts, thereby eroding the alliance's cohesion and effectiveness.

A House Divided

Divergence within NATO begins with the basic question of whether the alliance should allow sizable cuts in its own forces. France became acutely apprehensive about the future of NATO's and its own nuclear and conventional defenses with the signing of the Intermediate-Range Nuclear Forces (INF) Treaty in 1987. The treaty called for eliminating all Soviet and American land-based nuclear missiles with ranges between 300 and 3,400 miles.

Former ambassador JONATHAN DEAN is arms control adviser to the Union of Concerned Scientists. He was deputy U.S. representative and then U.S. representative to the NATO–Warsaw Pact Mutual and Balanced Force Reduction talks in Vienna from 1973 to 1981. This article is adapted from his book Meeting Gorbachev's Challenge, *to be published this year by St. Martin's Press and Macmillan.*

NATO disagreement over whether to restrict on-site inspection will complicate the verification debate with the Warsaw Pact.



With intermediate-range missiles out of the picture, France argued before the CFE talks began that there should be no further reductions in NATO forces, either conventional or nuclear. NATO had too few as it was, the French maintained, and needed them all to face the Soviets if they ever returned to militancy. French officials argued that the only way the Soviets could prove they wanted better relations with the West would be to reduce unilaterally their large numerical superiorities in ground forces. When West Germany insisted that NATO be seen by its own publics to make some reductions in its forces, France relented—but only grudgingly. And later, when they accepted President Bush's suggestion that combat aircraft be included in the CFE reductions, the French made clear in a footnote to NATO's decision paper that they would refuse to include any of their own nuclear-capable aircraft.

West Germany is more sanguine but still cautious. The German public is convinced that the Soviet Union under Gorbachev has become less aggressive. It expects NATO to make conventional and nuclear cutbacks if the Pact gives up its superiority in major ground-force weapons. But despite the public's mounting optimism, bolstered by Gorbachev's triumphant tour of the country in June 1989, the West German government pressed for only a token reduction in Western forces—5 to 10 percent.

As the NATO country bordering the largest concentration of Pact forces, West Germany felt strongly that larger cuts would compromise "forward defense." Under this strategy, NATO forces are placed along West Germany's 450-mile border with East Germany and Czechoslovakia, where they face a larger number of Warsaw Pact divisions. The aim is to provide maximum protection for the densely populated areas just behind the Western forces.

At issue here is the "force-to-space" ratio. It is a major reason many NATO governments entered the CFE talks viewing them as a trap rather than an opportunity. Most NATO officers argue that, depending on the terrain, a modern division can cover a maximum of about 25 miles of defensive line. The alliance's ground forces, they claim, are already spread too thin. In some hilly areas, a single division must cover more than 50 miles.

These officers point out that forward defense requires guarding the line of potential attack along its entire length. If there were too few Western divisions, the forward line could be breached easily. Hence, NATO officers argue, even if the Pact offered to withdraw a large number of its own forward divisions, NATO still could not reciprocate without giving up forward defense.

Certainly, a cordon of forward-deployed armored units is not the only way to defend NATO's Central Front border. One option is to position rapidly movable armored divisions behind a belt of forward-deployed infantry, minefields, and obstacles. Yet West Germany and many NATO commanders seem wedded to the tried-and-true.

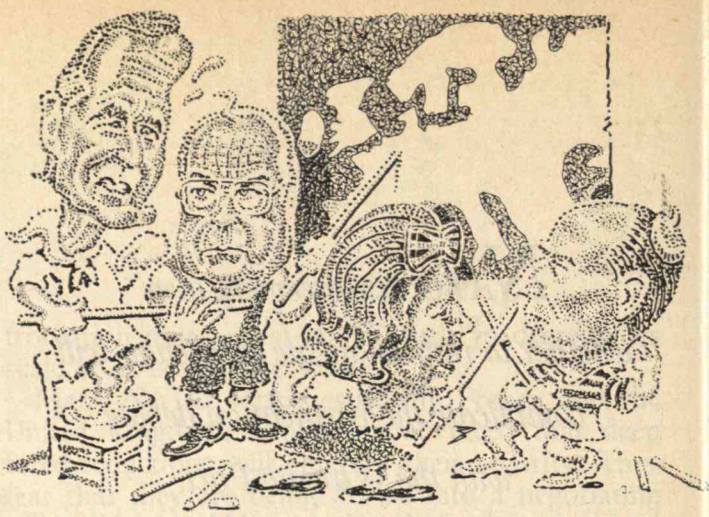
Most alliance members, including the United States, finally lined up behind West Germany in favor of a minimal cut in armaments and personnel, averaging about 10 percent of NATO's current strength. In its position paper at the start of the CFE talks, the alliance stated that it might be "willing to contemplate" further reductions if its initial program were achieved. But so far, the alliance seems locked by its forward-defense strategy into continuing the East-West military confrontation without much regard to how many cuts the Soviets are willing to make.

In addition to the matter of how many of its own forces the West should be prepared to give up, NATO is divided over a host of other questions. They include such issues as whether to impose ceilings on troops and armaments once cuts have been made, how to verify reductions, how to subdivide the territory on which the cuts will take place, and how to control weapons production.

Ceilings. "Residual ceilings"—caps to prevent either side from rebuilding after cutting back—are essential to an arms treaty. But they have become a bone of contention within the Western alliance.

NATO wants the Soviet Union to cut armaments

After much argument, NATO proposed establishing seven arms-control subregions in Europe, some of them gerrymandered and hard to justify.



by disbanding the units holding them. The only way to ensure that such reductions will last is to impose strict ceilings on the number of units of the same type, such as tank battalions, allowed each alliance. Unfortunately, both the United States and West Germany have resisted such ceilings so they can be free to restructure their forces after the cutbacks. If the two countries persist, the Soviet Union too can claim this right. For example, it might establish a larger number of new tank battalions with fewer tanks but with more soldiers and more weapons of other types, such as mortars and guided missiles.

Verification. After any weapons are cut and either destroyed or stored under the supervision of the opposing alliance, well over 100,000 armaments just like them, most of them highly mobile, will remain in service in each alliance. Making sure that they do not exceed agreed limits will require intensive, intrusive inspection, both on-site and from airplanes and helicopters. Yet some NATO governments seem more apprehensive about opening their territory to the Pact than interested in having the Pact open its territory to them.

Certain members—such as France and Turkey, both of which have limited experience in arms control and a tradition of keeping a close hold on military information—want to restrict on-site inspection by the Soviet Union. The United States, with no territory of its own involved, is more eager for tough verification measures. This divergence is likely to make the verification debate within the alliance and with the Pact a difficult one.

Subdividing Europe. For the purposes of the CFE talks, NATO has decided that the area from the Atlantic to the Urals should be divided into subregions. This will allow the negotiators to cut deepest where military forces are densest and to deter the remaining forces from concentrating along the dividing line between the alliances. The problem is that the zones NATO has proposed are based on a hard-won compromise covering a diversity of views. The alliance may thus be frozen into position, making it hard to reach a reasonable compromise with the Soviets.

During NATO's preparations for CFE, the United States opposed setting up subregions. It argued for seeking parity with the Warsaw Pact in selected armaments in the Atlantic-to-Urals area as a whole and for placing special "sufficiency" and "stationed-forces" limits on the Soviet Union. These limits, which the Soviets have now accepted in principle, forbid any one country from having more than 60 percent of its alliance's total of tanks, artillery, or armored troop carriers, and place a ceiling on the armaments one country can deploy on the territory of its allies.

West Germany, which wanted to reduce tensions along the Central Front without being saddled with treaty restrictions not shared by at least one other major member of the European Community, urged establishing a central subregion inside the Atlantic-to-Urals area. Besides West Germany, it would have been composed of France, the Benelux countries, East Germany, Czechoslovakia, Poland, and the three Soviet Western Military Districts. This area contains the bulk of forces that would be involved in at least the early stages of war in the vital Central European region.

But France refused to become part of such a zone. It did not want to be treated differently from the United Kingdom, the other major member of the European Community. It also rejected the U.S. proposal for parity between the two alliances in a single Atlantic-to-Urals area. France was determined to avoid the appearance that the CFE talks were between NATO and the Pact as two cohesive blocks. It did not want to create an unpopular impression among the French electorate that France was being pressed back into the NATO integrated command. So France suggested a subregion to be composed of itself, the U.K., West Germany, Italy, the Benelux countries, Spain, Portugal, and Denmark in the West and most of the Soviet Union to the Urals in the East. The NATO portion would contain most of the members of the Western European Union—NATO's precursor—which France has been pressing its

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Maintaining leadership in arms-control negotiations, even with a conciliatory Soviet Union, will require the president's constant attention.

European allies to revive as a focus for defense cooperation.

NATO wavered over France's suggestion. Some members, like Italy, were reluctant to bolster the Western European Union. Norway, Iceland, and Turkey objected to being isolated from the rest of NATO.

In the end, the alliance had to construct some very peculiar zones to accommodate all these desires. As the curtain rose on the CFE talks, the allies agreed in Vienna to establish seven subregions, some of them gerrymandered and hard to justify. But the delicate compromise was soon placed in jeopardy. In May 1989 the Warsaw Pact put forward its own complicated proposals, calling for dividing the Atlantic-to-Urals area into three subregions. Fortunately, the central regions proposed by both alliances are similar enough that differences here can probably be resolved. But negotiation of the other zones proposed by the Pact may be long and difficult because of the many national interests on the NATO side.

Threatening armaments. Disputes over zoning have caused whole classes of armaments to be left off the negotiating table. Forward deployment of hardware like tank transporters, bridging equipment, and ammunition stocks threatens both sides, because it increases the capacity for surprise attacks or large-scale offensives. But constraints on these armaments along the Central Front would subject West Germany to an arms-control regime shared by no other NATO state, a position that Germans are determined to avoid. As of several months after the talks began, NATO had still not made any proposals in this essential field.

Production limits. Both the Pact and NATO have major plants in the Atlantic-to-Urals area for producing tanks, aircraft, and artillery. Unless the manufacture of weapons that have been cut is limited in some way—at least by holding the new armaments in secured storage near the plants—the reductions will be meaningless. Yet some West European allies have refused to accept such controls unless they also cover production in the eastern USSR, and in the United States and Canada. U.S. officials have countered that the CFE reduction area is clearly restricted to Europe and does not include North America. The NATO position some months into the negotiations still contained no provision for such controls.

Needed: Consistent Leadership

Can NATO pull itself together to reach a first agreement and take greater advantage of Soviet flexibility on reducing forces? A treaty complete in all its details, including verification, is unlikely to emerge in the accelerated six- to twelve-month timetable the president proposed at the May NATO summit in Brussels. But a partial agreement is possible within that period if the United States exercises firm leadership.

If the United States does not take control, no one will. Although U.S. prestige in Western Europe has declined over the past decade, there is no successor to the United States among the European allies, either singly or in coalition. Dramatically, President Bush showed at the Brussels summit that the United States can still assume command. But leadership in a coalition arms-control negotiation, even with a conciliatory Soviet Union on the other side, is an exacting role that requires constant attention.

Because he has many other pressing responsibilities, the president needs to appoint a senior-level Washington-based coordinator for the talks. While reporting directly to the president, the coordinator could spend full time on resolving conflicts among Washington agencies like the State Department, the Defense Department, and the Joint Chiefs of Staff and among the allies, as well as on exploring specific issues with the Soviets.

But perhaps the best way for the United States to provide the leadership needed to achieve a force-reduction agreement is by trying to resolve two major problems that underlie much of the dissension within the alliance.

One is the absence of a long-term goal for force reductions. Without such a goal, it will be difficult

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Application of integrated circuit processing technology may lead to higher density packaging. For the U.S. Navy's VLSIC Packaging Technology (VPT) program, Hughes will apply its high-density multichip interconnect (HDMI) technique which uses integrated circuit processing technology to build the substrate circuitry in a hybrid package. The polymide dielectric used in the HDMI process is considered excellent for high-frequency device applications. The packaging technique is aimed at meeting the need for higher density hybrid microelectronics to take advantage of the next generation of integration using Very High Speed Integrated Circuits (VHSIC-II) chips.

A faster, deeper running, more accurate torpedo will counter enemy submarine threats through the year 2000. The Mk-48 Advanced Capability (ADCAP) wire-guided torpedo, under production at Hughes for the U.S. Navy, uses an advanced digital-based active sonar, an inertial measurement unit, a signal processor and two computers to home in on fast moving targets in shallow water, high seas, strong thermal gradients, even under ice. A long, thin communications wire between the torpedo and submarine serves as a real-time relay for changes in the torpedo's attack functions, improving the probability of interception.

Image processing computers will perform 100-billion operations per second in a package slightly larger than a tuna fish can. Under development by Hughes for the U.S. Air Force, the new 3-D Computer consists of a number of integrated circuit wafers stacked like records in a juke box. Each wafer contains a large array of processors with each processor connected directly to its four neighbors. Using a unique technology, signals are passed vertically through each wafer. Adjacent wafers are connected via "microbridges," permitting the distribution of signals to all other cells in a vertical column. The computer's signals are thus moving in three dimensions instead of two. This ultra-fast supercomputer will be used in space-based missions and applications like image and radar signal processing.

Engineers and scientists are eligible for approximately 100 Hughes Fellowships awarded for the pursuit of Master's and doctoral studies in Engineering and Science. All Fellows work full time at Hughes during the summer, with Work-Study Fellows working part time during the academic year and Full-Study Fellows attending classes full time. Fellows receive full academic expenses plus stipends for studies at approved universities. Additionally, Hughes offers a two-year, entry-level rotation program that enables qualified BS and MS graduates to diversify their engineering experience. For more information contact the Hughes Corporate Fellowship Office, Dept. S2, C1/B168, P.O. Box 45066, Los Angeles, CA 90045-0066. U.S. citizenship may be required. Equal Opportunity Employer.

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Force cuts of 50 percent would lessen the cost of the NATO-Pact confrontation yet still provide security in case Gorbachev's successors revert to expansionism.

to proceed rationally and effectively even to a first agreement. It is time for the NATO countries to conceive an objective that goes beyond continuing the East-West confrontation at a high level on terms more favorable to the West. Instead, NATO should be thinking about cuts an order of magnitude larger than it has allowed itself to contemplate.

There is still too much distrust between East and West for the two sides to move toward a completely demilitarized Europe. The Soviets themselves are not recommending any such thing. The cuts they have proposed would leave them with 40 to 50 percent of their current forces.

For their part, the Western countries have doubts about the future of the Soviet system. Even though Gorbachev is making a real effort to overhaul the system, and has consolidated his own power, no one knows how long he will last—in good health, withstanding efforts to supplant him, and without making major changes in his approach in the face of failure. Most of the plausible Gorbachev successors would probably continue the main lines of his current policy, since the economic problems that inspired it will persist. Yet as Andrei Sakharov has repeatedly warned, a sudden seizure of power by a group intent on reverting to confrontation and expansion cannot be ruled out.

True, it would be difficult or impossible for the new leadership to push the Soviet people back from today's enlightened authoritarianism to totalitarianism without losing their loyalty and cooperation. And chances are, the West would receive long political warning, not least through the thousands of personal contacts now being established. But given the uncertainties, the Western allies will continue to need effective armed forces in Europe.

At the same time, now that the Warsaw Pact has documented its interest in improving relations, NATO does not need to maintain its present strength. Instead, the alliance must find a goal midway between today's force levels and total East-West demilitarization in Europe. It ought to aim for reductions in offensive armaments and active-duty personnel of about 50 percent, with Warsaw Pact forces coming down to NATO's new level. This sharply reduced force level, backed by early-warning, verification, and constraint measures, will provide both sides with insurance against any future worsening of relations.

Cuts of such a magnitude have the further advantage of rolling back the cost of the NATO-Pact confrontation. The 5 to 10 percent arms reductions now on the table would produce very little savings in the defense budgets of any of the NATO allies, including the United States, which pays half the approximately $300 billion the alliance spends annually on the defense of Europe.

The 50 percent solution has its supporters. Such cuts have been proposed by Gen. Andrew Goodpaster, former supreme allied commander in Europe, and by Rep. Les Aspin (D-Wisc.), chairman of the House Armed Services Committee. In Europe, these cuts are backed by the German Social Democrats and other opposition parties.

The Warsaw Pact is calling for cuts to 40 percent below NATO levels. If a first agreement based on a 10 percent cut is achieved, NATO governments will face intense public pressure for further reductions. The choice will be between unilateral cuts by individual NATO countries, which would add to the frictions among them and preclude controls and verification measures that could insure against Soviet backsliding, and cuts achieved on a negotiated basis.

That is why NATO itself has alluded, however vaguely, to a second phase of reductions. Already, draft legislation in both houses of the U.S. Congress calls for the administration to submit studies of both a 25 percent and a 50 percent reduction. Defense departments and ministries in other NATO countries, while continuing to use the force-to-space argument, are now studying ways to structure forces after deeper cuts. Implemented in phases over the next decade, a 50 percent cut would give the West a less stressful, less costly posture from which to observe the long-term development of the Soviet Union.

If the United States agreed to keep some nuclear weapons in Europe, France and Britain would be less resistant to cuts in conventional forces.

Nuclear Politics

The other basic problem within NATO is the need for ways to cope with nuclear deterrence while building down the East-West confrontation. In the NATO countries, the two schools of opinion—that nuclear weapons are still essential, and that nuclear weapons must be eliminated—appear evenly balanced in strength. The adherents of deterrence are more influential on government policy; the abolitionists, more numerous. Supporters of deterrence make the impressive argument that, even after START reductions, the Soviet Union will remain a world nuclear power. Thus, they say, Western Europe will still need some counterbalancing nuclear force. Yet those favoring elimination of tactical nuclear arms from Europe make a valid point as well. Because of the INF treaty and the growth of antinuclear feeling in Europe, they say, NATO's strategy of flexible response—which leaves open the possibility of meeting Soviet aggression with first use of nuclear weapons—is no longer viable in its traditional form.

The two groups, almost like rival churches in their sectarian zeal, have the power to paralyze any efforts to negotiate cuts. For example, if West Germany, with its intensely antinuclear public, banished tactical nuclear weapons from its soil, NATO's two European nuclear powers, France and Britain, could well put the brakes on both conventional- and nuclear-arms talks. Alternatively, the two sects can agree to allow negotiated cuts in tactical nuclear weapons to a low equal level, moving toward a minimum deterrent on both sides and leaving to the long term the question of whether it will be possible to eliminate these weapons entirely.

The Soviet Union has taken an ambivalent approach to this issue. For the most part, it has waged a strong public campaign for eliminating all nuclear arms from Europe—a goal that Gorbachev furthered on his visit to France in July. If the West would agree to early negotiation on tactical nuclear arms, he said, the Soviet Union would unilaterally withdraw even more than the 500 such weapons it had already pledged to remove. At the same time, Soviet officials have shown a readiness to negotiate for a low equal level as an interim measure, indefinitely postponing their goal of elimination; on his French visit, Gorbachev proposed discussing a minimum deterrent.

The Bush administration needs to begin serious discussions of this issue with France and Britain. To allay their fears over long-term pressures to reduce their nuclear assets, the United States could agree to exclude their nuclear-armed submarines and nuclear-capable aircraft—and in the case of France, tactical surface-to-surface missiles—from a U.S.-Soviet negotiation on tactical nuclear arms. The United States might also offer, as a show of good faith, to collaborate with France and Britain in developing a nuclear-tipped air-to-surface standoff missile. These actions should lessen the resistance of both countries to cuts in conventional forces and, when the time comes, to cuts in Soviet and U.S. tactical-range nuclear arms in Europe.

To political parties and groups in Europe that want all tactical nuclear weapons eliminated, the administration needs to point out what their real choice is, at least for the short term: either sanction negotiated cuts in these arms to a low equal level, with the remaining weapons placed under verified ceilings, or watch the destructive friction within NATO continue, possibly stalling talks on both conventional and nuclear cuts. Once the choice becomes clear, most abolitionists will probably settle for negotiated cuts now and possible elimination later.

The administration ought then to make clear to the Soviets that their calls for totally eliminating tactical nuclear arms could block progress both in the CFE talks and in separate talks on tactical weapons. The administration should also point out that if such roadblocks occurred, the United States would be less eager to press for early progress in the START talks, and U.S.-Soviet relations and European stability could suffer. The Soviets, whose interest in improving relations with the West outweighs their interest in eliminating tactical weapons, would probably agree to restrict new talks to seeking a minimum deterrent at equal levels on both sides.

If its members can agree on the long-term aims of the reduction process and clarify the nuclear issue, NATO may well be able to move forward to an early first agreement in the CFE talks. Beyond that, it should be able to join with the Pact to bring about still deeper cuts in the East-West military confrontation. NATO countries will then enjoy greater security at far less cost as the Eastern Bloc goes through its metamorphosis. ■

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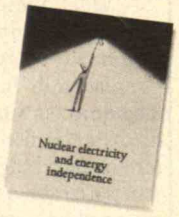

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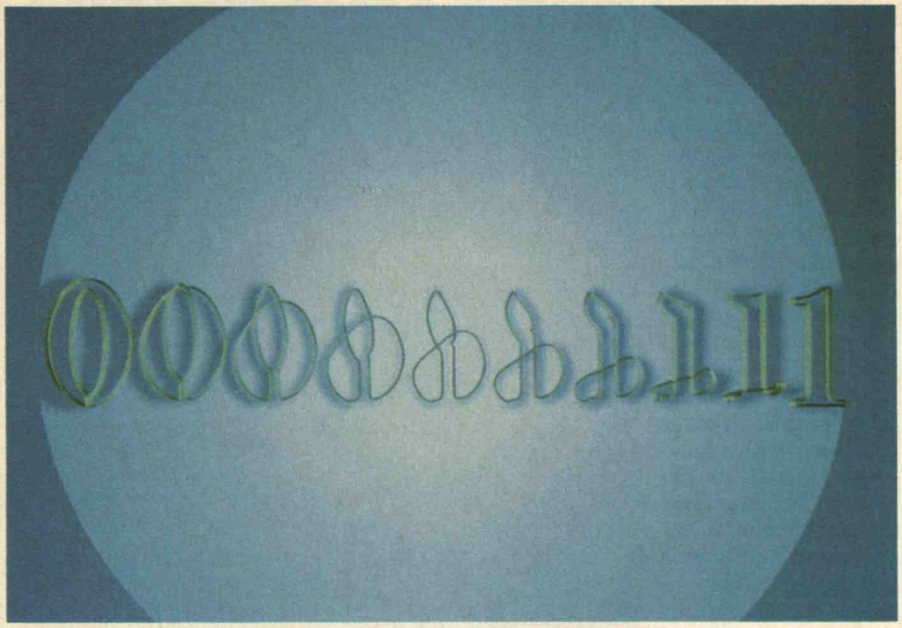
Reviews

THE ARTS

Art in the Computer Age

Computer Art in Context
The SIGGRAPH 1989 Art Show
(Catalogue, $45.00)

BY ROGER F. MALINA



Kamran Moojedi*, Number Series, *Stereolithograph, 60 x 12 x 1 in., 1989

At the time of the first shows in the 1960s, computer art was a curiosity, produced mainly by interested scientists and engineers. Gradually, artists found ways to collaborate with technologists, and today software has become versatile enough—and artists computer literate enough—to generate computer art that expresses a personal aesthetic vision.

The SIGGRAPH computer art show, held in Boston last summer at The Computer Museum, is a case in point. Since 1981, SIGGRAPH (the computer graphics "special interest group" of the Association for Computing Machinery) has held a juried computer art exhibition in conjunction with its annual conference. This year's show featured 74 works in a bewildering variety of media.

Some took forms that art viewers have come to expect of computer art—plotter drawings, photographs of screen displays, digital colorprints, computer animation, and the like. But most of the art in the SIGGRAPH exhibition—ink sketches on paper, acrylic paintings on canvas, lithographs, pastel drawings, even one bronze sculpture—did not look as though it involved a computer at all.

This suggests that artists have found ways to use the computer as an intermediary in almost any medium or style. But if the technology simply allows artists to make traditional art in a different way, why bother? Or in other words, just what is computer art?

The Ideal Sketchpad

For many of the artists represented in the SIGGRAPH show, the computer functions essentially as a labor-saving device—an ideal sketchpad on which versions of a work can be tried out with great ease. For instance, a typical paint program allows the artist to change color schemes rapidly, automatically execute thousands of variations, then select the most interesting. Or if a given direction of visual exploration reaches a dead end, the artist can retrieve a promising intermediate stage and develop the artwork in a new direction.

Some artists in the show use this capacity to chart the evolution of a visual image and to comment on the theme of transformation. In *Woman's Work,* for example, Rosalyn Muskovitz creates 25 versions of an image with a drawing program, then sketches them in ink on paper. The initial sketch in the series shows a woman who appears to be kneeling, beating laundry, perhaps at a riverside. In subsequent sketches she is transformed into shapes resembling first the Statue of Liberty, then a wood stove with a large pot of water—perhaps filled with boiling laundry—on top.

Kamran Moojedi's stereolithograph *Number Series* shows the transformation of the numeral *0* into the female sexual organ, then the male sexual organ, and finally the numeral *1*. The work is a visual pun on digital processing and gender. Moojedi seems to suggest that when we focus on the binary opposites, we miss all the exciting variety in between.

Algorithmic Art

"Algorithmic" or "math" art exploits another labor-saving capacity of the computer—its ability to rapidly calculate algorithms and thus explore the mathematical foundations of visual phenomena. Of course, long before computer art became popular, some artists were arguing that mathematics could be used as a theoretical basis for visual ideas. In the 1960s, painters produced op art—visually disturbing displays and illusions using simple geometric figures. And for many years, sculptor Max Bill has created works based on topological shapes such as the Möbius strip.

A number of the works in the SIGGRAPH show continue this tradition. In *Untitled (reference #87),* Jean-Pierre Hebert uses an algorithm to distort a simple array of lines and squares. The wrinkles and folds that result yield a tactile, textural quality.

Fractals constitute another category of math art. Fractal mathematics—the study of geometries with fractional dimensions—produces shapes that are just as complex in their details as they are in their overall form. Math art is often thought of as cold and unexpressive, but most fractal patterns are marvelously organic and in fact resemble designs found in nature. Increasingly, artists are using fractals to create representational images such as landscapes with clouds, trees, and mountains.

Artists have found ways to use the computer in almost any medium or style.

Jean-Pierre Herbert, Untitled (reference #87), Ink on paper (plotter drawing), 26 x 26 in., 1989

In an essay he has contributed to the exhibition catalogue, Benoit Mandelbroit, who pioneered much of fractal mathematics, points out that although it is possible to draw fractal designs by hand, it is ridiculously time-consuming. Even if fractal mathematics had been available to artists before the computer was introduced, it still would have made far more sense for them to create landscapes with a paintbrush rather than by calculation. Now, however, the combination of the computer and fractal mathematics allows artists to mathematically simulate many natural phenomena.

In another catalogue essay, computer artist Herbert Franke argues that math art holds the key to creating a truly scientific foundation for aesthetics. The approach allows artists to mathematically analyze their theories about composition, form, and other aesthetic categories. Here, math art comes close to the scientific field of "visual mathematics" where researchers use computer-generated visual displays to study the properties of mathematical systems.

A Qualitatively New Medium

But some artists and art theorists have charged that most existing computer art lacks originality. The "pointillist" painters of the late nineteenth century fully explored the visual effects that colored "pixels" in paint programs lend themselves to. And the supernatural landscapes many computer graphics artists produce reveal no visual ideas that weren't developed by the surrealists some 50 years ago.

It's true that from the perspective of art history, computer art is not significant unless it exploits the unique properties of the technology. This kind of art, which constitutes a qualitatively new medium, was underrepresented at the SIGGRAPH show—partly because there is not much of it, partly because it is difficult to display in a museum setting.

One example of a more original approach to computer art emphasizes interactivity—the technology's ability to modify its next operation based on new inputs. For instance, some artworks incorporate digital video. When a camera detects something different in the environment—say, a person coming to look at the work—it triggers a response in the software. The SIGGRAPH show featured *Electric Anthill*, an interactive installation by Michael Travers that allows viewers to direct the construction of an artificial ant colony. Depending on what "behaviors"—such as food-gathering or eating—viewers select for each of the ants, the colony develops in a particular way and the images on the computer screen change.

Of course, all art is interactive in the sense that during composition, the artist is constantly reassessing the result. But as Travers's work suggests, the computer takes interactivity to a new level. The artist is really creating a "family" of potential artworks, and events in the environment contribute to the final result. In the most complex of these works, the artist defines an artificial reality founded on a set of explicit rules. But it is the viewer who interacts with the artist's rules and actually creates the art.

Other computer art, not represented in the SIGGRAPH show, experiments with artificial intelligence and knowledge engineering. The computer becomes the junior partner in a creative team. Consider Harold Cohen's program AARON (on permanent display at the Computer Museum). It produces works by implementing rules that govern the placement of lines drawn by a plotter. As Cohen's own ideas about the drawings have evolved, he has modified the program so that there has been a stylistic evolution in the work. Artist Roman Verostko has adapted a plotter to carry a paintbrush and programmed an expert system to produce Chinese-style paintings. Researchers such as George Stiny, Russell and Joan Kirsch, and Ray Lauzzana have been developing various rule systems that produce art in the style of well-known artists like Richard Diebenkorn, Joan Miró, and Wassily Kadinsky.

The promise of these approaches is that they are open-ended in a way simple computer paint programs are not. Where the latter tend to produce works that all look pretty much the same, expert systems introduce an element of uncertainty and growth. The end result is often quite different from what the artist originally predicted.

Another approach not represented in the SIGGRAPH show is to make art not with a single computer but with entire computer networks. For instance, at the 1983 Electra

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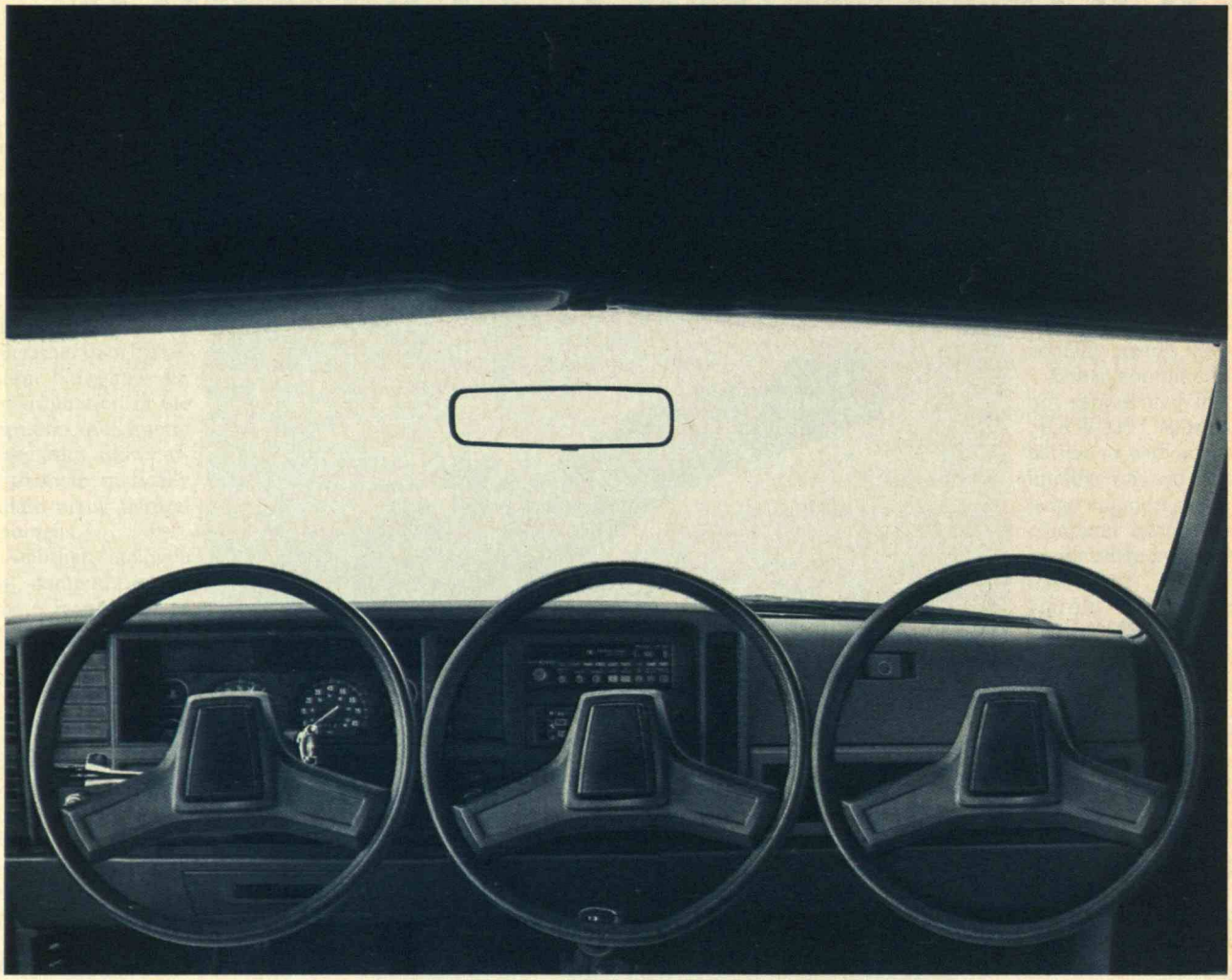

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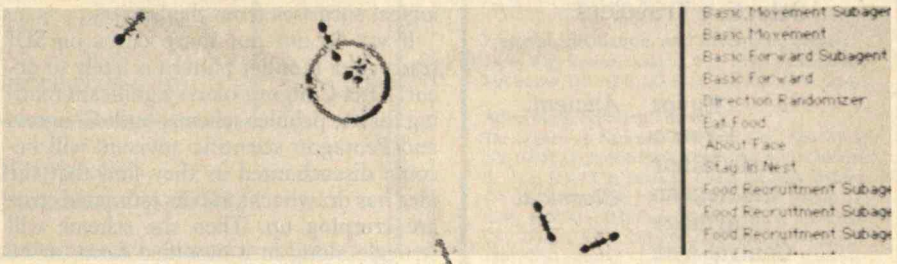
The computer may change not only how we make art but also how we define it.



Michael Travers*, Electric Anthill, *Interactive installation, 1989

exhibition in Paris, artist Roy Ascott set up a work called *La Plissure du Texte*—in English, *The Weaving of the Text*. Artists in 11 cities around the world were assigned roles from a conventional fairy tale—"witch," "princess," "wizard," and so on. Each contributed text and images about his or her character via computer to the central site in Paris. As a narrative emerged, it was sent back to the participants who then added new material. Some artists used the entire work as the starting point for local exhibitions and performances.

A similar work is featured at this year's Ars Electronica Festival, held annually in September in Linz, Austria. Called *Gaia*, it uses a worldwide computer network to give artists from cultures who normally do not have access to computers—Inuits in the Arctic, Aborigines in Australia, Indians in South America—the opportunity to contribute images and sound to the piece displayed in Austria. Computer art of this type is very hard to evaluate or even classify—perhaps another reason it was absent from the SIGGRAPH show. But it offers the tantalizing prospect of creating global art.

The more visionary computer artists like to predict that the computer will change not only how we make art but also how we define it. After all, other major technologies—such as photography and film—have transformed contemporary art. The computer will almost certainly do the same. The real question may be not so much "What is computer art?" but "What will art become in the computer age?" ■

ROGER F. MALINA is an astronomer at the University of California's Space Sciences Laboratory in Berkeley. He is also executive editor of Leonardo, *the journal of the International Society for the Arts, Sciences, and Technology. The Computer Art in Context catalogue is available from* Leonardo, *Box 421704, San Francisco, CA 94142.*

FORUM

CONTINUED FROM PAGE 21

ing fiscal year. The Bush administration requested $4.6 billion, while the House voted to appropriate $3.1 billion. Opponents of missile defense estimate that $1 billion is enough to pursue laboratory research that could guard against technological surprises from the Soviets.

If we do not put sharp curbs on SDI research, a familiar pattern is likely to occur. After Congress okays significant funding for the pebbles scheme, both Congress and Pentagon scientific advisors will become disenchanted as they find that the idea has drawbacks and its estimated costs are creeping up. Then the scheme will struggle along in a modified form, or be abandoned. In that event, a new defense concept will surely be offered.

The $17 billion spent since 1983 on SDI—more than given to the National Science Foundation and the National Cancer Institute during the same period—has shown that a missile defense cannot be deployed in the near to middle future. With the chimera of early deployment put to rest, limited lab research can refute schemes like brilliant pebbles before they consume so many political and economic resources. ■

FIRST LINE

CONTINUED FROM PAGE 3

from an extra unit or two can make the difference in allowing a home builder to qualify for a mortgage. Each new unit keeps the construction trades busy solving the housing crisis rather than aggravating it through renovation. More liberal zoning might allow homeowners to build "in-law" apartments legally. And urban housing shortages will only be eased if surrounding cities and towns—there are dozens in the Boston metropolitan area—also liberalize their zoning codes.

Housing policy today primarily addresses demand rather than increases supply. The federal government provides "Section 8" and other rental vouchers. In theory, this is a good idea, but many low-income renters with vouchers cannot find apartments. As of April 1987 the New York Housing Authority had been able to use less than a quarter of the vouchers assigned to it. A bill recently introduced in the Senate would allow first-time home buyers to use IRAs and other tax-exempt savings without a penalty for the down-payment. But if this money goes for purchasing existing units rather than building new ones, it will only boost the cost of housing further and aggravate the crisis.
—Jonathan Schlefer

LETTERS

CONTINUED FROM PAGE 4

CALCULATING RADIATION RISKS

"Chernobyl Fallout" by Seth Shulman (*TR February/March 1989*) suggests that radiation risks may have been underestimated in the past. So far, so good. There is indeed some chance of this, based on current studies of Japanese survivors of the atomic bombing.

However, Shulman badly confuses the issue with some absolutely wild ideas regarding purported effects of the Chernobyl fallout. He backs up his claims with unpublished literature, the views of eccentric scientists, and such almost certainly irrelevant "evidence" as a transient decline in bird populations noted at one observatory in California. In Shulman's view it is apparently appropriate to attribute any biological aberrance of 1986 to Chernobyl. But the truth is that if the minute exposures associated with that accident in North America produced any detectable effects, then everything we know about radiation biology and epidemiology would be turned upside down. Strangely enough, Shulman never thinks to ask why there was not an increase in mortality after the much higher exposures from weapons fallout in the 1950s and 1960s.

I challenge *Technology Review* to send the piece to some respectable radiation scientists for review. I will bet a copy of the *National Enquirer* that it will not survive such scrutiny.

LEONARD A. SAGAN
Palo Alto, Calif.

Leonard A. Sagan is program manager of radiation studies at the Electric Power Research Institute.

The author responds:
If I made any claim in my article, it was that, as one of my sources noted, the issue of low-dose carcinogenesis presents a "minefield of controversy." The "claims" Mr. Sagan attributes to me are nothing more than my reporting of the research of Ernest Sternglass and Jay Gould, and I introduce their work as representing "perhaps the most controversial" views in the field.

SPORTS TECHNOLOGY

I am outraged at Langdon Winner's proposal that we establish a special "Enhanced Olympics" in which performance-boosting drugs are sanctioned (*"The Era of the Enhanced Athlete," TR February/March 1989*). Such drugs have no place in sports at all, especially on the amateur level. Does Winner really think that steroids, for example, are safe? What will happen to "enhanced" athletes when their livers stop functioning in 30 years? Or when their hearts become so dilated that their standing pulse rate is 150 beats a minute?

Continued on page 79

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NO MORE WISHFUL THINKING

By Harold B. Finger
President and Chief Executive Officer
U.S. Council for Energy Awareness

For too long, wishful thinking has dominated energy policy. The wishful thinkers tell us we don't need to build more power plants. They tell us we don't need to drill for oil and natural gas in frontier areas. They always have easy ways to avoid the problem.

They're dangerously wrong. We have an energy crisis coming. First, we're increasing our dependence on foreign oil and, in the process, gambling with our energy independence and our national security. Second, electricity demand is growing faster than new supplies are being added because of our continued economic growth. In some parts of the country, electric reliability is already threatened.

It's time to face up to our energy needs realistically. We cannot depend on "what if..." scenarios that won't deliver results for years, if at all.

Let's drop the wishful thinking and look at the facts instead.

In the last 15 years, since the 1973 oil embargo, the U.S. has made great strides in conserving energy and improving efficiency of energy use. Since 1973, our Gross National Product has grown 46 percent, but our *total* energy consumption has risen only 8 percent. That's great progress.

But those numbers don't tell the whole story. During that same period, demand for electricity has grown about 50 percent—roughly parallel with GNP growth. Clearly, electricity has fueled much of the growth in the U.S. economy over the past 15 years. And we must have additional, reliable, affordable supplies of electricity if our economy is to continue to grow.

For many reasons, most of them beyond the electric industry's control, plans for adding new generating capacity are not keeping up with increasing demand. Construction of new power plants is at a 15-year low. New capacity planned over the next 10 years will support growth in electric sales of only one percent per year. That's one-fourth the rate of growth we've experienced over the last six years.

The Oil Problem

Building new power plants is only part of the solution. We must also ask ourselves: what kind of power plants? The U.S. is already dangerously dependent on foreign oil and that dependence is rising. Imports represent nearly 50 percent of U.S. oil consumption. Last year, payments for foreign oil accounted for about one-third of our trade deficit and that bill is increasing.

What does this have to do with electricity? Today, over 25 percent of U.S. electric capacity is still fueled by oil and natural gas. Because oil-fired electricity is costly, electric utilities try to reserve that capacity for times of very high demand. If we don't meet rising electric demand with domestic fuels—like nuclear energy and coal—utilities will be forced to use those oil-fired plants more of the time, worsening our foreign oil dependence and boosting our electricity costs.

Unfortunately, we're already moving in that direction. Back in 1973, electric utilities used about 1.5 million barrels of oil per day. By 1987, thanks largely to new coal and nuclear electric power plants, utilities had cut that to about 500,000 barrels per day. But in 1988, utility oil use increased—to 675,000 barrels per day, a 24 percent increase. And by the mid-1990s, utilities will be burning about 1.8 million barrels per day—almost all of it imported. That's worse than 1973. Our nation is so dependent on foreign oil for other uses, like transportation, that we simply cannot afford to make the situation worse by using foreign oil to generate electricity.

The Nuclear Energy Solution

We can head off looming problems, and nuclear energy should be an important part of our energy strategy.

Nuclear energy has not always been a financial blessing for electric utilities, because of punitive treatment by state regulators who have refused to let companies recover the cost of building the plants. But nuclear energy has been an unmixed blessing for the U.S. and its people.

Nuclear energy is our second largest source of electricity, after coal. U.S. nuclear plants have cut consumer electricity costs by over $50 billion since the 1973 oil embargo. The spent fuel from all our commercial nuclear plants has been managed scrupulously at carefully controlled sites. And our plants have operated safely. We learned much from the Three Mile Island accident. The jolt it gave the industry's confidence led to substantial improvements in operation and design. The trends in plant performance tracked by the Nuclear Regulatory Commission and the Institute of Nuclear Power Operations prove this. They show steady improvement in all areas of nuclear plant performance.

Finally, our nuclear plants have reduced oil imports. Since 1973, nuclear energy has displaced nearly 4 billion barrels of oil and cut our foreign oil payments by over $114 billion.

With such a record, there's no question that nuclear energy should play a larger role in supplying our future electricity needs.

These are facts. Wishful thinking cannot deliver so well.

Harold B. Finger

A View From Washington is a series of essays sponsored by corporations and associations. The views expressed do not necessarily reflect those of the magazine.

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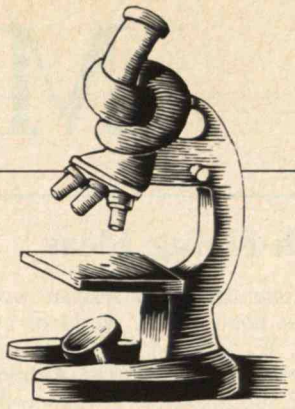

As to the author's concern that we make inconsistent decisions about which sports technologies are acceptable, what does he think the purpose of the International Olympic Committee (IOC) is? This group publishes a list of all banned substances and training techniques so that there is really no inconsistency whatsoever. Winner also stipulates that "care would have to be taken" to avoid "blatantly hazardous" practices, but the primary reason the IOC bans specific sports technologies is that they indeed can harm athletes. Ironically, Winner would eliminate a certain inconsistency only to create another—which would center on the question of what measures are "blatantly hazardous."

Winner does not understand how strongly people disapprove of performance-boosting drugs. Spectators respect the amateur athlete who works for love of the sport rather than a paycheck, and they balk at the implication that all the discipline, sacrifice, and training can be reduced to something the size of a pill. His proposal would never win popular support.

Finally, Winner mentions that power lifting and bodybuilding have begun to create competitions in which drug use is the norm, but in fact this has happened only because drug use has grown out of control, not because people have accepted drugs. Moreover, it is important to make a distinction between professional and amateur athletics. Professional bodybuilders and power lifters are rewarded with money, and their competition may be their only means of sustenance. Thus, they may find it much more difficult to resist performance-boosting drugs.

KEVIN WILLIAMS
Cambridge, Mass.

TAKING THE LONG VIEW IN SCIENCE

In "The Worsening Climate for Biological Research" (*TR May/June 1989*), David Baltimore correctly observes that public disaffection might seriously undermine efforts to attract bright young scholars to university work in biology. Replenishing the professoriate in the biological sciences could prove even more difficult.

In addition to Baltimore's recommendations for restoring public trust, I suggest that we encourage a historical perspective on the course of scientific advancement, noting the role that patience, persistence, and serendipity have played in solving major riddles. The typical course of scientific progress bears little if any resemblance to the brief time frame in which so much of modern culture resides. The anti-intellectualism Baltimore cites is fueled by the modern emphasis on the quick fix, the sound bite, the transitory.

WILLIAM E. COOPER
Iowa City, Iowa

MIT Reporter

High-Flying Ideas

The Jetson cartoon characters would be quite at home in the world of aviation Robert W. Simpson speculates could be the norm by the year 2020. Airliners that hold 2,000 passengers, easy-to-fly personal helicopters for thousands of commuters, and only a couple of traffic controllers for the entire North Atlantic airspace are just some changes the MIT professor of aeronautics and astronautics sees in his crystal ball.

The force behind most of these changes will be the continuing advance in information technology, Simpson suggested at a Department of Transportation symposium on aviation in the twenty-first century. For instance, sophisticated computer and telephone systems could allow most large corporations to hold electronic conferences with participants worldwide, obviating much of the need for business travel. This could mean that most airline travel would consist of pleasure trips, he says, acknowledging that his ideas are full of "whimsical uncertainty."

By the year 2020 airlines might offer passengers amenities such as sleeping berths and restaurants "spread over three decks [that] accommodate up to 2,000 travelers." Frequent Flyer programs could also change, becoming "volume-discount schedules where the actual price charged to each traveler's credit card depends upon the dollar amount of travel in the last 12 months."

Personal helicopters for commuters may become much more common in the next 30 years, Simpson adds. Electronic cockpits likely to be developed in the 1990s could make the helicopters so inexpensive and easy to use that the New York area alone could support thousands of helicopter sites.

Another sector of the aviation business that Simpson thinks will finally boom is the air-cargo industry. If cheap labor in Asia and Africa increases the amount of manufacturing done there, and the "just-in-time" production concept becomes standard worldwide, fast transport of parts and materials will be vital.

The increased air-cargo services and new, larger passenger planes will result in more air traffic, Simpson predicts. Yet this need not present a problem. That's because by 2020 the air traffic control (ATC) system that tells personnel on the ground about an aircraft's position will probably carry much more information than the craft identification and altitude data now offered. Details on many factors, including wind and aircraft speed and direction, will probably be entered automatically into an enormous computer system that will route and reroute air traffic. Combined with a broad-area surveillance system that will likely rely on satellites instead of radar, improved computerization might even permit one or two controllers to handle thousands of flights at one time. Just a couple of people might direct all the air traffic over the North Atlantic, Simpson speculates. (However, this system probably won't cover all the helicopters in use, since at lower levels the pilots might be responsible for their own safety.)

Nevertheless, the increased number of airplanes will cause serious headaches on the ground. Unless aviation industry leaders recognize the need to continue developing quieter airplanes, community concerns about noise pollution will make it impossible to expand major airports or construct new ones near large cities, Simpson believes. Some major cities will address the problem by building airports on islands constructed in their harbors.

Robert W. Simpson, professor of aeronautics and astronautics, sees information technology as the key to radical changes in the nation's air traffic in the next three decades.

Knowledge of Cosmos Less Than Stellar

Almost half of a random sample of more than 1,100 adults do not think the sun is a star, and about two of every five people do not believe it will burn out. Moreover, a majority—59 percent—think the universe is static rather than expanding, according to a survey developed by Alan Lightman, MIT professor of science and writing and a senior physics lecturer, and Jon D. Miller, professor of political science at Northern Illinois University.

The findings indicate more than just a widespread naiveté about current astronomical thinking, says Lightman, who is intrigued with the public's understanding of astronomy because of the field's speculative nature. The belief that the universe doesn't change, which is held by three-quarters of those who based their responses on personal opinion, may suggest an innate preference for stability and control, he notes. Lightman's idea is supported by the answers to questions that he and Miller asked people who believe in a static universe.

Not surprisingly, astronomical understanding appears related to education and other social factors, say Lightman and Miller, who describe their research in the journal *Social Studies of Science*. Men, younger and better educated people, and non-churchgoers were most likely to respond correctly to four basic questions about the cosmos. In addition to the question about whether the universe is static and the two about the sun, Lightman and Miller asked if people agreed that there are "thousands of planets . . . on which life could have developed."

Chalk up one point for most respondents—62 percent agreed. Overall, however, only 10 percent answered every question correctly.

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